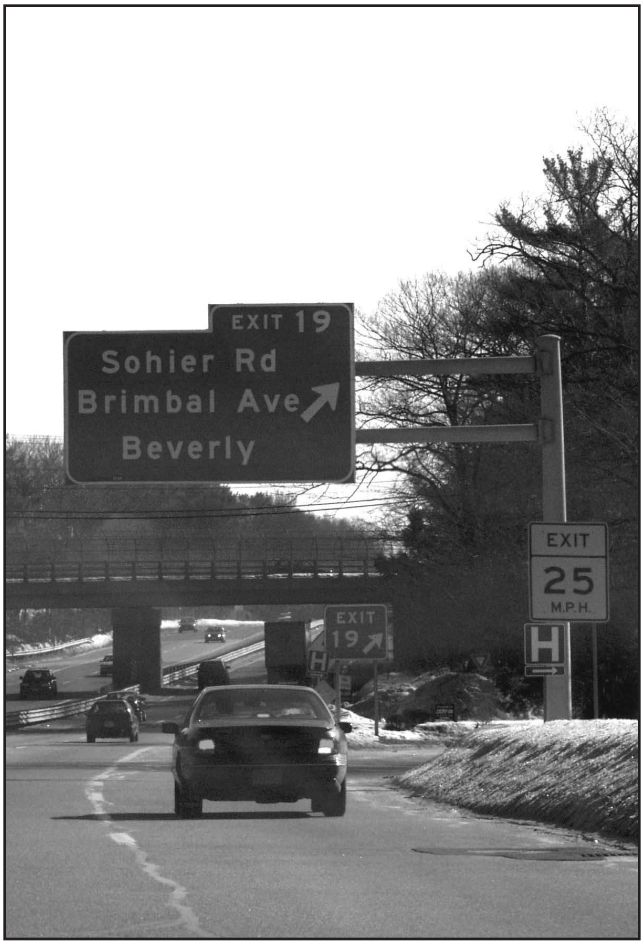
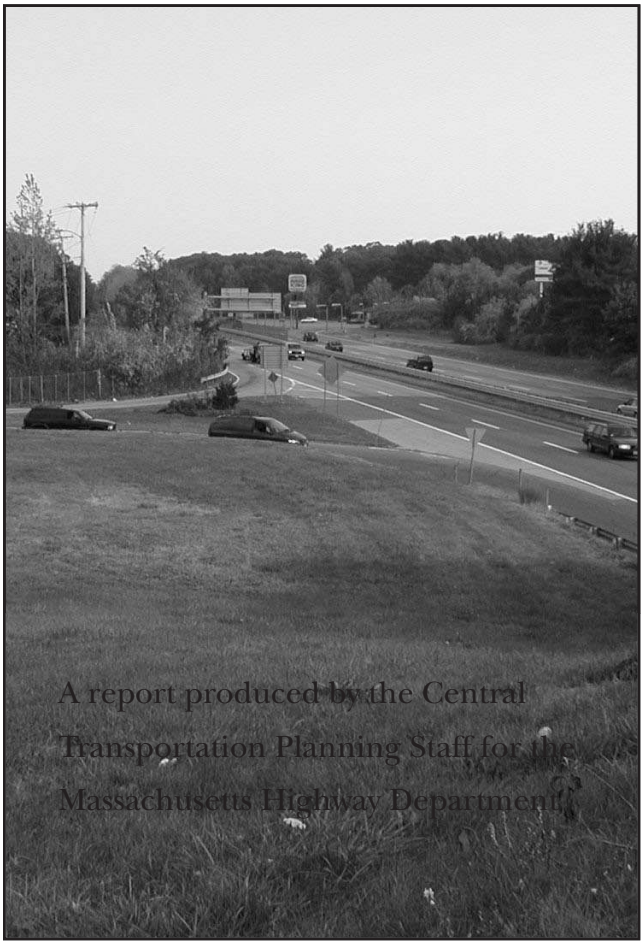
Feasibility Analysis of Safety and Operational Improvements at Eleven Route 128 Interchanges in Beverly, Wenham, Manchester-by-the-Sea, and Gloucester





A report produced by the Central Transportation Planning Staff for the Massachusetts Highway Department

Feasibility Analysis of Safety and Operational Improvements at Eleven Route 128 Interchanges in Beverly, Wenham, Manchester-by-the-Sea, and Gloucester

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TABLE OF CONTENTS

LIST OF FIGURES v
LIST OF TABLES vi

1 INTRODUCTION 1
1.1 Background 1
1.2 Public Participation 1
1.3 Objectives 1
1.4 Study Procedure 2

2 EXISTING TRAFFIC CONDITIONS 5
2.1 Traffic Data Collection and Processing 5
2.2 Analysis Method 9
2.3 Route 128 Capacity Analysis 10
2.4 Interchange Capacity Analysis 11
2.5 Interchange Geometry Review 22

3 CRASH DATA ANALYSIS 25
3.1 Data Collection and Analysis Method 25
3.2 Analysis of Selected Locations 25
3.3 Summary of Findings 28

4 FUTURE TRAFFIC CONDITIONS 41
4.1 Projection of Future Traffic Volumes 41
4.2 Route 128 Capacity Analysis 42
4.3 Interchange Capacity Analysis 50

5 DEVELOPMENT OF CONCEPTUAL IMPROVEMENTS 57
5.1 Exit 10: Route 128 at Blackburn Circle, Gloucester 57
5.2 Exit 11: Route 128 at Grant Circle, Gloucester 57
5.3 Exit 12: Route 128 at Craft's Road, Gloucester 58
5.4 Exit 13: Route 128 at Concord Street, Gloucester 58
5.5 Exit 14: Route 128 at Essex Avenue (Route 133), Gloucester 59
5.6 Exit 15: Route 128 at School Street, Manchester-by-the-Sea 59
5.7 Exit 16: Route 128 at Pine Street, Manchester-by-the-Sea 60
5.8 Exit 17: Route 128 at Grapevine Road, Wenham 60
5.9 Exit 18: Route 128 at Essex Street, Beverly 60
5.10 Exit 19: Route 128 at Brimbal Avenue, Beverly 61
5.11 Exit 20: Route 128 at Route 1A, Beverly 61

6 RECOMMENDATIONS 87
6.1 Short-Range Improvements 87
6.2 Long-Range Improvements 88
6.3 Consideration of Aesthetics 88

APPENDICES

A. Public Participation
    1) July 2002 North Shore Task Force Meeting Agenda
    2) January 2003 North Shore Task Force Meeting Agenda
    3) Written Comments
B. Base Year (2001) Peak Period Balanced Traffic Volumes
C. Base Year (2001) Peak Hour Balanced Traffic Volumes
D. Base Year (2001) Interchange Capacity Analyses
E. Future (2025) No-Build Peak Period Traffic Volume Forecasts
F. Future (2025) No-Build Peak Hour Traffic Volume Forecasts
G. Future (2025) No-Build Interchange Capacity Analyses

LIST OF FIGURES

1-1 Study Area Interchanges 3
2-1 2001 AM Peak Hour Traffic Volumes, Route 128 Mainline....7
2-2 2001 PM Peak Hour Traffic Volumes, Route 128 Mainline 8
2-3 2001 Peak Hour Capacity Analysis, Exit 11: Route 128 at Grant Circle, Gloucester 18
2-4 2001 Peak Hour Capacity Analysis, Exit 18: Route 128 at Essex Street, Beverly 19
2-5 2001 Peak Hour Capacity Analysis, Exit 19: Route 128 at Brimbal Avenue, Beverly 20
2-6 2001 Peak Hour Capacity Analysis, Exit 20: Route 128 at Route 1A, Beverly 21
3-1 Collision Diagram (1/1/99–12/31/01), Exit 10: Route 128 at Blackburn Circle, Gloucester 31
3-2 Collision Diagram (1/1/99–12/31/01), Exit 11: Route 128 at Grant Circle, Gloucester....33
3-3 Collision Diagram (1/1/99–12/31/01), Exit 14: Route 128 at Essex Avenue, Gloucester 35
3-4 Collision Diagram (1/1/99–12/31/01), Exit 19: Route 128 at Brimbal Avenue, Beverly 37
3-5 Collision Diagram (1/1/99–12/31/01), Exit 20: Route 128 at Route 1A, Beverly....39
4-1 2025 Peak Hour Capacity Analysis, Exit 11: Route 128 at Grant Circle, Gloucester 52
4-2 2025 Peak Hour Capacity Analysis, Exit 18: Route 128 at Essex Street, Beverly 53
4-3 2025 Peak Hour Capacity Analysis, Exit 19: Route 128 at Brimbal Avenue, Beverly 54
4-4 2025 Peak Hour Capacity Analysis, Exit 20: Route 128 at Route 1A, Beverly 55
5-1 Conceptual Improvements, Exit 10: Route 128 at Blackburn Circle, Gloucester 63
5-2 Existing Interchange Layout, Exit 11: Route 128 at Grant Circle, Gloucester.... 65
5-3 Conceptual Improvements, Exit 12: Route 128 at Craft's Road, Gloucester 67
5-4 Conceptual Improvements, Exit 13: Route 128 at Concord Street, Gloucester 69
5-5 Conceptual Improvements, Exit 14: Route 128 at Essex Avenue, Gloucester.... 71
5-6 Conceptual Improvements, Exit 15: Route 128 at School Street, Manchester-by-the-Sea 73
5-7 Conceptual Improvements, Exit 16: Route 128 at Pine Street, Manchester-by-the-Sea.... 75
5-8 Conceptual Improvements, Exit 17: Route 128 at Grapevine Road, Wenham.... 77
5-9 Conceptual Improvements, Exit 18: Route 128 at Essex Street, Beverly.... 79
5-10 Existing Interchange Layout, Exit 19: Route 128 at Brimbal Avenue, Beverly 81
5-11 Conceptual Improvements, Concept A, Exit 20: Route 128 at Route 1A, Beverly 83
5-12 Conceptual Improvements, Concept B, Exit 20: Route 128 at Route 1A, Beverly 85

LIST OF TABLES

2-1 Summary of Capacity Analyses, Existing (2001) Traffic Conditions, Route 128 Southbound Mainline Segments 13

2-2 Summary of Capacity Analyses, Existing (2001) Traffic Conditions, Route 128 Northbound Mainline Segments 13

2-3 Summary of Capacity Analyses, Existing (2001) Traffic Conditions, Route 128 Southbound Ramp/Rotary Junctions and Weaving Sections 14

2-4 Summary of Capacity Analyses, Existing (2001) Traffic Conditions, Route 128 Northbound Ramp/Rotary Junctions and Weaving Sections 15

2-5 Summary of Capacity Analyses, Existing (2001) Traffic Conditions, Route 128 Southbound Ramp Termini 16

2-6 Summary of Capacity Analyses, Existing (2001) Traffic Conditions, Route 128 Northbound Ramp Termini 17

2-7 Overview of Interchange Ramp Deceleration and Acceleration Lengths 23

3-1 Summary of Crash Data (1/1/96–12/31/00) 26

3-2 Summary of Crash Data (1/1/99–12/31/01), Route 128 at Blackburn Circle (Exit 10), Gloucester 30

3-3 Summary of Crash Data (1/1/99–12/31/01), Route 128 at Grant Circle (Exit 11), Gloucester 32

3-4 Summary of Crash Data (1/1/99–12/31/01), Route 128 at Essex Avenue (Exit 14), Gloucester 34

3-5 Summary of Crash Data (1/1/99–12/31/01), Route 128 at Brimbal Avenue (Exit 19), Beverly 36

3-6 Summary of Crash Data (1/1/99–12/31/01), Route 128 at Route 1A (Exit 20), Beverly 38

4-1 Summary of Peak Hour Traffic Volumes, Existing (2001) and Future (2025) No-Build Traffic Conditions, Route 128 Southbound Mainline Segments 44

4-2 Summary of Peak Hour Traffic Volumes, Existing (2001) and Future (2025) No-Build Traffic Conditions, Route 128 Northbound Mainline Segments 44

4-3 Summary of Capacity Analyses, Existing (2001) and Future (2025) No-Build Traffic Conditions, Route 128 Southbound Mainline Segments 45

4-4 Summary of Capacity Analyses, Existing (2001) and Future (2025) No-Build Traffic Conditions, Route 128 Northbound Mainline Segments 45

4-5 Summary of Capacity Analyses, Existing (2001) and Future (2025) No-Build Traffic Conditions, Route 128 Southbound Ramp/Rotary Junctions and Weaving Sections 46

4-6 Summary of Capacity Analyses, Existing (2001) and Future (2025) No-Build Traffic Conditions, Route 128 Northbound Ramp/Rotary Junctions and Weaving Sections 47

4-7 Summary of Capacity Analyses, Existing (2001) and Future (2025) No-Build Traffic Conditions, Route 128 Southbound Ramp Termini 48

4-8 Summary of Capacity Analyses, Existing (2001) and Future (2025) No-Build Traffic Conditions, Route 128 Northbound Ramp Termini 49

1 INTRODUCTION

1.1 Background

In response to requests from state and local officials of the North Shore, the Massachusetts Highway Department (MassHighway) initiated this study to analyze the feasibility of safety and operational improvements at 11 interchanges along Route 128 in Beverly, Wenham, Manchester-by-the-Sea, and Gloucester. The Central Transportation Planning Staff (CTPS) was asked to assist MassHighway with the analysis of traffic conditions and the development and evaluation of conceptual alternative improvements.

1.2 Public Participation

The study team consulted with the North Shore Task Force (NSTF)[1] to receive information and comments on the study. Analyses of existing conditions were presented to the NSTF on July 11, 2002 and final recommendations were presented on January 16, 2003. Both meetings were well attended, and representatives of the North Shore communities offered comments. The agendas of the two meetings and correspondences from the communities are provided as Appendix A. The study was also presented to state legislators from the North Shore communities on December 18, 2002, at the State House.

1.3 Objectives

The study area is the Route 128 corridor from Exit 10 (Blackburn Circle) in Gloucester to Exit 20 (Route 1A) in Beverly (see Figure 1-1). This section of the highway was designed about 50 years ago, when its main function was to provide access to the seashore area. Travel was mainly recreational, and the surrounding area was generally in an undeveloped rural condition. Today, recreational trips continue, and new developments in the area produce additional traffic, including commuting, school, shopping, and other types of trips. Many of the interchanges now appear to be inadequate to handle the increasing traffic, and some of them cause safety concerns. The objectives of this study were:

- To identify locations with safety or operational concerns.
- To review the interchanges' existing geometry in light of current design standards.
- To project and analyze future (2025) traffic conditions.
- To develop improvement concepts.
- To recommend short-range and long-range improvements.

[1] North Shore Task Force is one of the MAPC (Metropolitan Area Planning Council) subregions. Its members consist of representatives from the North Shore communities: Beverly, Danvers, Essex, Gloucester, Hamilton, Ipswich, Manchester-by-the-Sea, Marblehead, Middleton, Peabody, Rockport, Salem, Swampscott, Topsfield, and Wenham.

1.4 Study Procedure

The study procedure involved traffic and crash data collection and analysis, geometric design, travel demand modeling, and various traffic analysis and evaluation techniques. The major tasks were to:

- Collect and process traffic counts.
- Collect and analyze crash data.
- Analyze existing traffic conditions.
- Calibrate travel demand model and produce 2025 traffic forecasts.
- Evaluate 2025 traffic operations based on traffic forecasts.
- Develop conceptual improvement alternatives.
- Recommend short-range and long-range improvements.

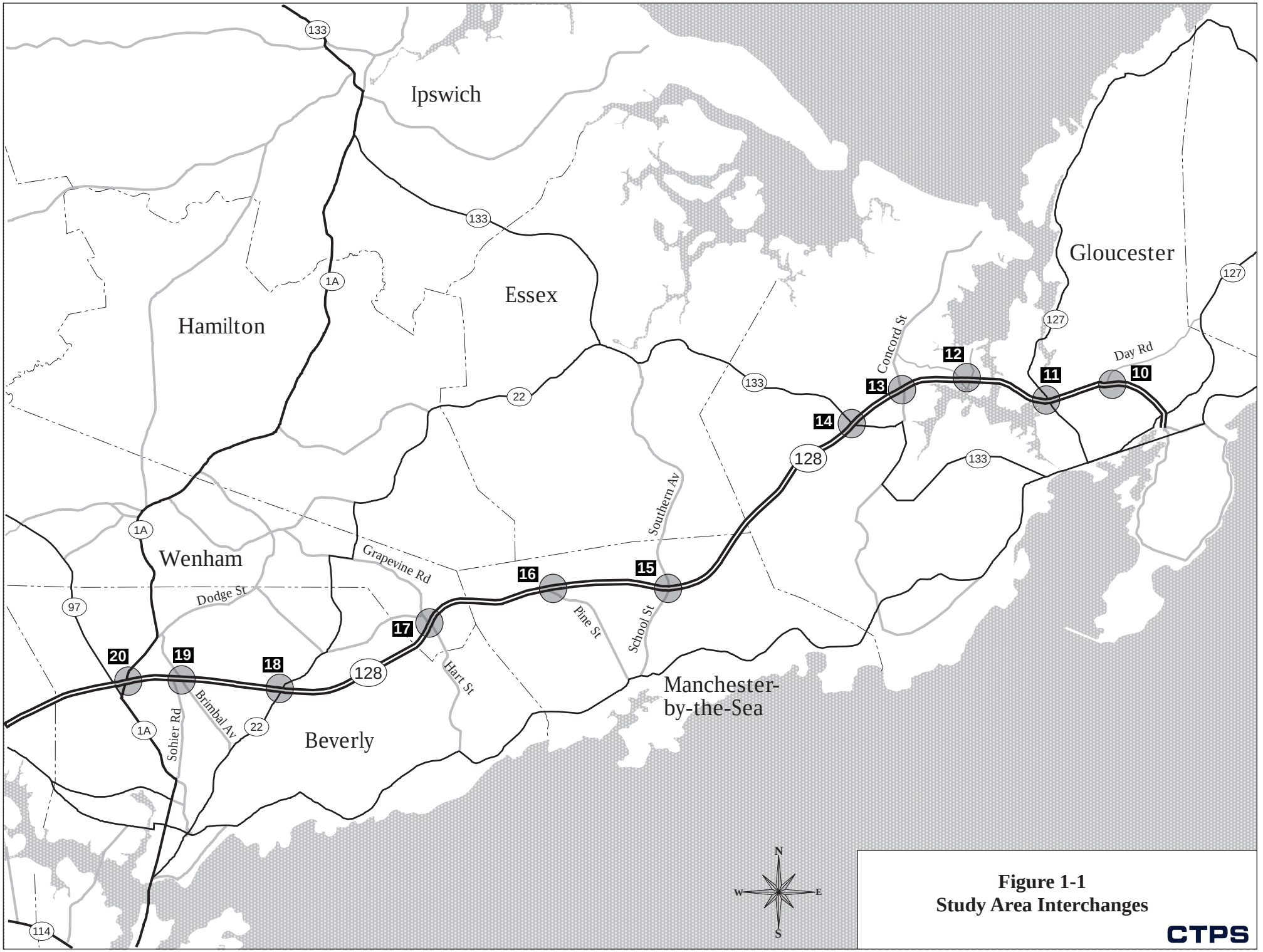

Figure 1-1
Study Area Interchanges

CTPS

2 EXISTING TRAFFIC CONDITIONS

Route 128 between Exit 10 in Gloucester and Exit 20 in Beverly is a major arterial on the National Highway System. It has two travel lanes in each direction. The peak traffic direction in the morning is southbound and in the evening is northbound. During site reconnaissance, traffic congestion was observed during the morning and evening peak hours at Exit 11 (Grant Circle) in Gloucester, Exit 19 (Brimbal Avenue) in Beverly, and Exit 20 (Route 1A) in Beverly. The other interchanges in the study area did not appear to be congested. However, most of the interchanges appeared to have limited acceleration and deceleration distance for entering and exiting Route 128. The existing conditions at all of the interchanges were thoroughly investigated by way of the data collection and analyses.

2.1 Traffic Data Collection and Processing

This section describes the collection of traffic volume data and the subsequent development of balanced AM and PM traffic volumes for analysis purposes. CTPS produced both peak hour and peak period balanced traffic volumes along the entire Route 128 corridor between Beverly and Gloucester. The balanced peak hour traffic volumes were used for the base-year traffic operation analyses. The balanced peak period volumes were used for the base-year traffic model calibration. MassHighway and CTPS collected two types of traffic data:

- 24-hour directional traffic counts: These were collected at two permanent count stations and at locations on segments of Route 128 and on streets that intersect Route 128 at the 11 interchanges. MassHighway staff collected these data using automatic traffic recorders (ATRs) between July 31st and November 1st of 2001.
- 2-hour AM (7:00–9:00) and PM (4:00–6:00) turning movement counts: These were collected manually at locations corresponding to the ramps of the 11 interchanges, including the two rotaries, in the study area. CTPS staff collected these data in July 2001. Turning movement counts at Exit 11 (Grant Circle) in Gloucester were recollected in March 2002.

Seasonal Adjustments

In order to portray average weekday traffic conditions in the study area, CTPS made a few adjustments to the data. First, CTPS examined the annual counts that were collected at the two permanent count stations to ascertain whether seasonal adjustments should be made to the ATR data collected in the summer and fall of 2001. The AM peak period ATR data collected in the summer and in the fall were found to be comparable to typical monthly volumes. In the case of the PM peak period ATR data, those collected in the fall were comparable, but not those collected in summer. The latter data were factored down by 10% to discount additional summer trips.

Peak Hours and Peak Periods

CTPS then used the 24-hour counts to determine the AM and PM peak hours along Route 128 in the study area. It was decided that the AM peak hour was 7:45−8:45 and PM was 5:00−6:00. CTPS calculated peak period expansion factors from the 24-hour counts to produce peak period volumes for the hours of 6:00−9:00 AM and 3:00−6:00 PM. The directional peak period expansion factors were derived by reviewing the 24-hour traffic volumes on the Route 128 mainline and on the interchanged streets. The data indicated that traffic volumes during the AM peak hour were 39.6% of the peak period and that traffic volumes during the PM peak hour were 36.0% of the period.

Balanced Volumes

To produce balanced peak hour traffic volumes, CTPS extracted peak hour turning movements at each interchange from the collected two-hour turning movement counts, based on the identified AM and PM peak hours. The balanced peak hour volumes were then produced through an iterative process of streamlining Route 128 mainline counts and fine-tuning the peak hour turning movements. Finally, CTPS applied the peak period expansion factors to the balanced peak hour traffic volumes to produce the balanced peak period traffic volumes.

Figure 2-1 shows the AM peak hour balanced volumes on the Route 128 mainline. The numbers shown are total volumes for two lanes in each direction. The volumes in the peak direction (southbound) ranged from 500 to 1,000 vehicles per hour per lane before Exit 18 (Essex Street in Beverly). Traffic started to increase after Exit 18 and reached over 1,700 vehicles per hour per lane after Exit 20.

Figure 2-2 shows the PM peak hour balanced volumes on the Route 128 mainline. In the PM peak hour, traffic in the peak direction (northbound) started to decrease from 1,800 vehicles per lane before Exit 20 (Route 1A in Beverly) to 1,250 vehicles per lane before Exit 18. The volumes ranged from 600 to 1,100 vehicles per hour per lane after Exit 18.

Detailed AM and PM peak period balanced traffic volumes for the 11 interchanges are shown individually in Figures B-1 to B-11 in Appendix B. AM and PM Peak hour balanced traffic volumes for the interchanges are shown in Figures C-1 to C-11 in Appendix C.

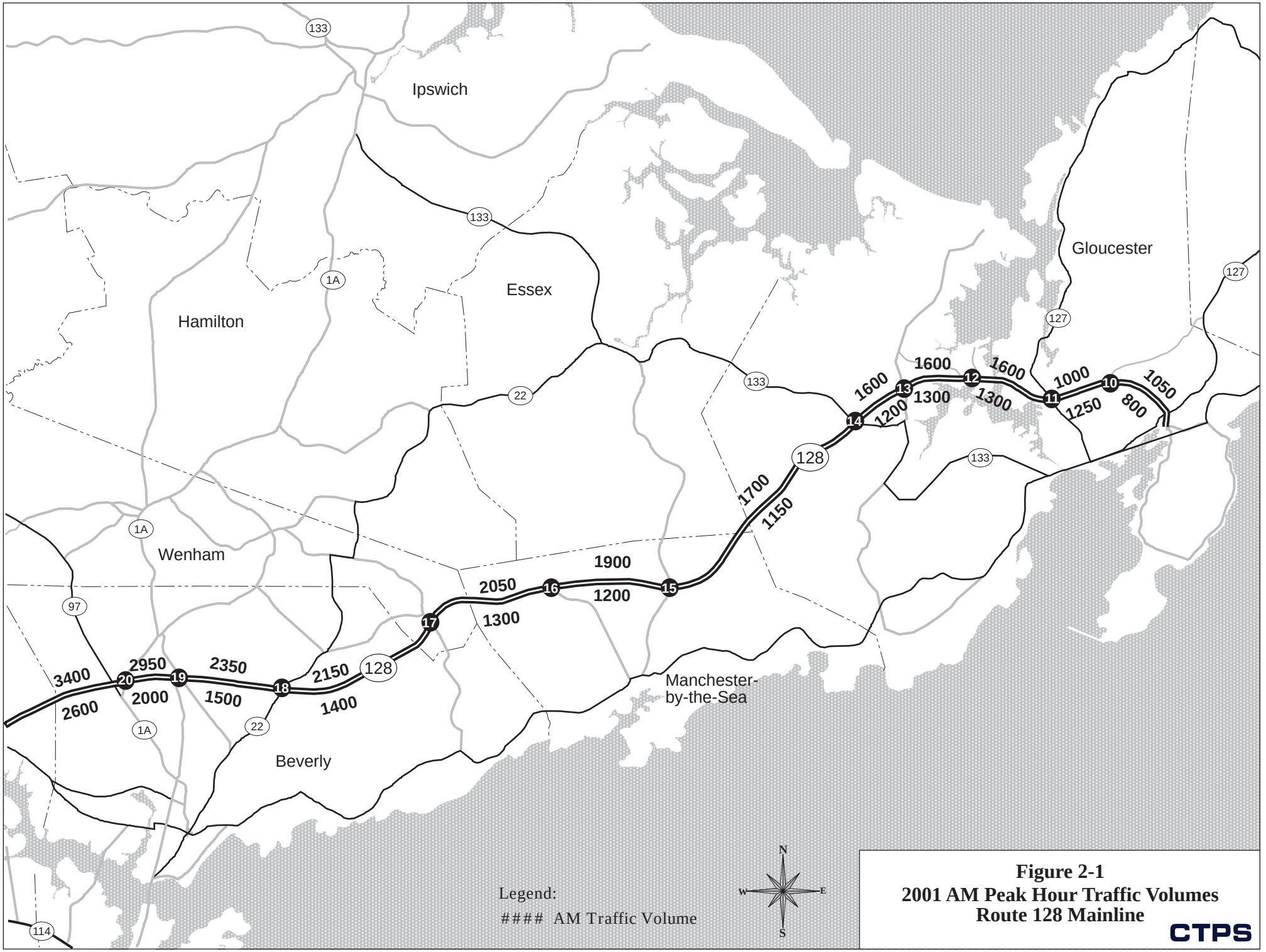

Figure 2-1
2001 AM Peak Hour Traffic Volumes
Route 128 Mainline

CTPS

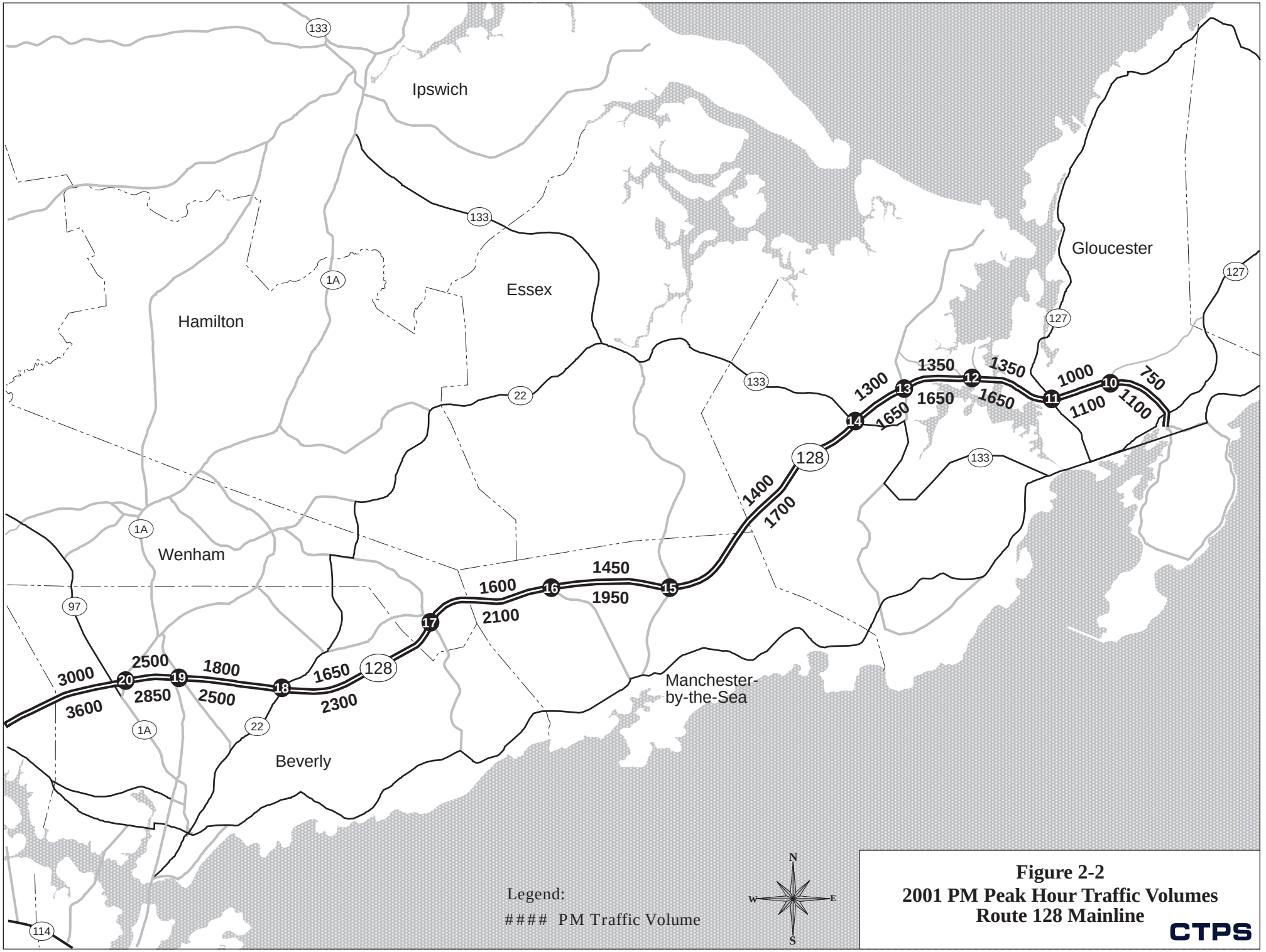

Figure 2-2
2001 PM Peak Hour Traffic Volumes
Route 128 Mainline

CTPS

2.2 Analysis Method

The existing traffic conditions at the 11 interchanges were examined by analyzing their operational capacities and reviewing interchange geometry. The capacity analyses were conducted by using the level of service (LOS) measure demonstrated in the Highway Capacity Manual.[1] LOS is a qualitative measure of traffic conditions at a facility that gives it a rating from A to F. The characteristics used to determine LOS vary by type of facility and include roadway and travel demand parameters. In this study, LOS was calculated for locations at each of the 11 interchanges based on the data collected and processed for average weekday conditions in the AM peak hour of 7:45−8:45 and in the PM peak hour of 5:00−6:00. Levels of service A through D are considered acceptable, E and F are considered undesirable.

The method used to calculate LOS varies by types of traffic operation along the highway corridor. Five types of highway operations were analyzed:

- Mainline segments: Route 128 mainline segments were analyzed between Exit 21 in Danvers and Exit 9 in Gloucester. The analysis was performed using the *Freeways* program in Highway Capacity Software (HCS-2000),[2] which is based on the Highway Capacity Manual 2000. Inputs included peak hour highway volumes, percentage of heavy vehicles, free-flow speed, and roadway geometry.
- Ramp junctions: Highway merging and diverging sections were analyzed at nine interchanges, except Exits 10 and 11. Ramp junctions are points of potential turbulence along the mainline where, under LOS F conditions, queues that block lanes of traffic can form. Ramp junctions were analyzed using the *Ramps* program in HCS-2000. Inputs include peak hour highway and ramp volumes, percentage of heavy vehicles, and roadway geometry. Some ramp junctions in the study area, such as those of the Route 128 northbound and southbound on-ramps at Exits 12,13 and 14 have very limited acceleration distance for entering the highway. The HCS *Ramps* program has a limited capacity of analyzing this condition. These locations were analyzed using the *Unsignalized* program in HCS-2000.
- Rotaries: Rotary operation analyses were conducted at Exit 10 and Exit 11 in Gloucester. The Highway Capacity Manual contains analysis of roundabouts but does not address rotaries. CTPS used aaSIDRA[3] to calculate lane delays for all approaches entering the two rotaries. These lane delays were measured against delay standards in the Highway Capacity Manual to determine the LOS for each rotary overall and for each of the approaches to the rotary. Inputs included balanced peak hour turning movements, percentage of heavy vehicles, and geometry.
- Weaving areas: Weaving areas are usually between an on-ramp and an off-ramp that closely follows it downstream. Points of turbulence arise when two or more vehicle flows cross each other's path. Two locations, one on each direction, on Route 128 at Exit 20

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[1] *Highway Capacity Manual*, Transportation Research Board, National Research Council, Washington, D.C., 2000.

[2] Highway Capacity Software (HCS), developed and maintained by the McTrans Center at the University of Florida, is a faithful implementation of Highway Capacity Manual procedures. Release 4.1b was used.

[3] Also known as SIDRA (Traffic **S**ignalised & unsignalised **I**ntersection **D**esign and **R**esearch **A**id), Release 1.0.6, Akcelik & Associates, Australia, 2002.

require this type of operation. Weaving areas were analyzed using the *Weaving* program in the HCS-2000. Inputs included peak hour highway mainline, merging, and diverging volumes, percentage of heavy vehicles, and roadway geometry.

- Ramp termini: Ramp termini are the locations where the highway on- and off-ramps meet with arterial or collector roads. They are analyzed as signalized or unsignalized intersections depending on the type of traffic control they have. In this study, ramp terminus LOS was measured by the same criteria used to measure LOS at an unsignalized T intersection and was analyzed using the *Unsignalized* program in HCS-2000. Inputs include peak hour turning movements on the ramps and the interchanged local streets, percentage of heavy vehicles, and roadway geometry.

In addition to capacity analysis, the existing geometry of each of the 11 interchanges was reviewed in light of the standards in the current Highway Design Manual[4]. The basic geometric elements reviewed for each interchange were acceleration/deceleration distance, entrance/exit ramp radius, and weaving distance.

2.3 Route 128 Capacity Analysis

The analyses in this study involve many locations and different types of traffic operation. To present an overall picture as well as individual portraits, these analyses were summarized at two levels: the study corridor as a whole and the interchanges as individuals. This section looks at the corridor as a whole, summarizing the capacity analyses for mainline segments, ramp junctions, rotaries, weaving areas on Route 128 and adjacent ramp termini. The next section addresses the analyses of the individual interchanges and focuses on those with capacity concerns.

Mainline Segments

The analyses of mainline segments on Route 128 indicated that most locations north of Exit 19 (Brimbal Avenue in Beverly) operate at acceptable levels of service. The balanced traffic volumes indicate moderate mainline traffic in the section north of Exit 19 and heavy traffic in the section at and south of Exit 20 (Route 1A in Beverly). The mainline segments north of Exit 19 operate at LOS C or better (see Table 2-1 for southbound mainline segments and Table 2-2 for northbound mainline segments). South of Exit 19, as traffic volume increases, levels of service deteriorate to D in the morning for the southbound traffic and to D and E in the afternoon for the northbound traffic. The northbound segment of Route 128 south of Exit 20 operates at LOS E in the evening peak hour. This indicates that volume has reached capacity at this location and that delays are frequent.

Ramp Junctions, Rotaries, and Weaving Areas

In addition to mainline segments, levels of service for ramp junctions, rotaries, and weaving areas on Route 128 were reviewed. Table 2-3 summarizes the capacity analyses of the southbound locations based on the balanced AM and PM peak hour traffic volumes. Southbound is the peak direction in the AM peak hour. All of the locations except Exit 11

[4] *Highway Design Manual*, 1997 Edition, MassHighway.

were found to operate at acceptable levels of service (D or better) in both the AM and PM peak hours. At Exit 11, the Washington Street westbound approach operates at LOS F in both peak hours. This indicates that volumes are over capacity and that extensive delays are common. Some locations at Exit 19 and at Exit 20 operate at LOS D. This indicates that volumes are approaching capacity at these locations.

Table 2-4 summarizes the capacity analyses for the Route 128 northbound locations based on the balanced AM and PM peak hour traffic volumes. Northbound is the peak direction in the PM peak hour. All locations were found to operate at acceptable levels of service (D or better) in both the AM and PM peak hours, except some locations at Exits 11 and 19. At Exit 11, Route 128 northbound entering the rotary was analyzed as LOS E in the PM peak hour, and Washington Street entering the rotary was analyzed as LOS F in both the AM and PM peak hours. At Exit 19, the junction of the Brimbal Avenue on-ramp with Route 128 northbound operates at LOS E in the PM peak hour.

Ramp Termini

Capacity analyses were also conducted for ramp termini—the intersections of Route 128 off- and on-ramps intersect with local streets. Table 2-5 summarizes the capacity analyses for the termini of the ramps along southbound Route 128. All the locations were found to operate at acceptable levels of service. Table 2-6 summarizes the capacity analyses for the termini of the ramps along northbound Route 128. All of these locations were found to operate at acceptable levels of service, except some locations at Exits 18, 19, and 20. The deficiencies of these locations are discussed individually in the next section.

2.4 Interchange Capacity Analysis

The results of the capacity analyses of each of the 11 interchanges are presented in Figures D-1 to D-11. It was found that Exits 11, 18, 19, and 20 have one or more locations with capacity concerns. The results of the capacity analyses of these four interchanges are shown in Figures 2-3 to 2-6 and discussed below.

Exit 11, Route 128 at Grant Circle, Gloucester

This interchange is under rotary operation. The capacity analysis shows that the Washington Street approach operates at LOS F in both the AM and PM peak hours and that the Route 128 northbound approach operates at LOS E in the PM peak hour (see Figure 2-3). Vehicles on Washington Street experience intensive delay waiting to enter the rotary, especially during the PM peak hour.

Exit 18: Route 128 at Essex Street (Route 22), Beverly

All of the locations at this interchange except one were found to operate at acceptable levels of service (see Figure 2-4). The left-turn movement from Route 128 northbound exit-ramp onto Essex Street operates at LOS F in both the AM and PM peak hours. Vehicles making this movement are under a stop control and have to wait for traffic gaps on Essex Street. They

experience delay due to high traffic volumes on Essex Street, especially in the PM peak hour. Field observation indicates a 5- to 10-vehicle queue in the AM peak hour and a 10- to 15-vehicle queue in the PM peak hour.

Exit 19: Route 128 at Brimbal Avenue, Beverly

Three locations at this interchange operate at undesirable levels of service (see Figure 2-5). Two of them are ramp termini and one is a ramp junction. The left-turn approaches of the two ramp termini operate at LOS F in both the AM and PM peak hours. The on-ramp junction with Route 128 northbound operates at LOS E in the PM peak hour due to high traffic volumes on Route 128.

Exit 20: Route 128 at Route1A, Beverly

The capacity analyses at this interchange indicate that one mainline location and two ramp terminus locations operate at undesirable levels of service (see Figure 2-6). Route 128 northbound operates at LOS E in the PM peak hour. The terminus of the ramp from Route 128 northbound to Route 1A southbound operates at LOS D in the AM peak hour and at LOS F in the PM peak hour. The terminus of the ramp from Route 128 northbound to Route 1A northbound operates at LOS E in the AM peak hour and at LOS F in the PM peak hour.

Table 2-1
Summary of Capacity Analyses
Existing (2001) Traffic Conditions
Route 128 Southbound Mainline Segments

Route 128 Mainline Location	Level of Service	
	AM	PM
Before Exit 10	A	A
Between Exit 10 and Exit 11	A	A
Between Exit 11 and Exit 12	B	B
Between Exit 12 and Exit 13	B	B
Between Exit 13 and Exit 14	B	B
Between Exit 14 and Exit 15	B	B
Between Exit 15 and Exit 16	B	B
Between Exit 16 and Exit 17	C	B
Between Exit 17 and Exit 18	C	B
Between Exit 18 and Exit 19	C	B
Between Exit 19 and Exit 20	D	C
After Exit 20	D	D

Table 2-2
Summary of Capacity Analyses
Existing (2001) Traffic Conditions
Route 128 Northbound Mainline Segments

Route 128 Mainline Location	Level of Service	
	AM	PM
Before Exit 20	C	**E***
Between Exit 20 and Exit 19	C	D
Between Exit 19 and Exit 18	B	C
Between Exit 18 and Exit 17	B	C
Between Exit 17 and Exit 16	B	C
Between Exit 16 and Exit 15	B	C
Between Exit 15 and Exit 14	B	C
Between Exit 14 and Exit 13	B	B
Between Exit 13 and Exit 12	B	B
Between Exit 12 and Exit 11	B	B
Between Exit 11 and Exit 10	B	A
After Exit 10	A	A

* Boldface indicates undesirable level of service.

Table 2-3
Summary of Capacity Analyses
Existing (2001) Traffic Conditions
Route 128 Southbound Ramp/Rotary Junctions and Weaving Sections

City/Town	Exit	Ramp/Rotary/Weaving Location	Level of Service	
			AM	PM
Gloucester	10	Route 128 southbound entering Rotary	A	A
		School St. entering Rotary	B	C
		Dory Rd. entering Rotary	C	B
	11	Route 128 southbound entering Rotary	C	C
		Washington St. westbound entering Rotary	**F***	**F**
		Washington St. eastbound entering Rotary	C	C
	12	Causeway St. off-ramp	B	B
		Old County Rd. on-ramp	C	B
	13	Concord Rd. off-ramp	C	B
		Concord Rd. on-ramp	B	B
	14	Essex Ave. off-ramp	C	B
		Essex Ave. on-ramp	C	B
Manchester by-the-Sea	15	School St. off-ramp	C	B
		School St. on-ramp	C	B
	16	Pine St. off-ramp	C	B
		Pine St. on-ramp	C	B
Wenham	17	Grapevine Rd. off-ramp	C	B
		Grapevine Rd. on-ramp	C	B
Beverly	18	Essex St. off-ramp	C	C
		Essex St. on-ramp	C	C
	19	Brimbal Ave. off-ramp	C	C
		Brimbal Ave. northbound on-ramp	C	C
		Brimbal Ave. southbound on-ramp	D	C
	20	Route 1A northbound off-ramp	C	C
		Route 1A northbound on-ramp	D	C
		Weaving section between on-ramp and off-ramp	C	B
		Route 1A southbound off-ramp	C	C
		Route 1A southbound on-ramp	D	D

* Boldface indicates undesirable level of service.

Table 2-4
Summary of Capacity Analyses
Existing (2001) Traffic Conditions
Route 128 Northbound Ramp/Rotary Junctions and Weaving Sections

City/Town	Exit	Ramp/Rotary/Weaving Location	Level of Service	
			AM	PM
Beverly	20	Route 1A southbound off-ramp	C	D
		Route 1A southbound on-ramp	C	D
		Weaving section between on-ramp and off-ramp	B	D
		Route 1A northbound off-ramp	C	C
		Route 1A northbound on-ramp	C	D
	19	Brimbal Ave. off-ramp	C	C
		Brimbal Ave. on-ramp	C	**E***
	18	Essex St. off-ramp	B	C
		Essex St. on-ramp	C	D
Wenham	17	Grapevine Rd. off-ramp	B	C
		Grapevine Rd. on-ramp	B	C
Manchester by-the-Sea	16	Pine St. off-ramp	B	C
		Pine St. on-ramp	B	C
	15	School St. off-ramp	B	C
		School St. on-ramp	B	C
Gloucester	14	Essex Ave. off-ramp	B	B
		Essex Ave. on-ramp	B	C
	13	Concord Rd. off-ramp	B	C
		Concord Rd. on-ramp	B	C
	12	Craft's Rd. off-ramp	B	C
		Craft's Rd. on-ramp	B	C
	11	Route 128 northbound entering Rotary	C	**E**
		Washington St. eastbound entering Rotary	C	C
		Washington St. westbound enterning Rotary	**F**	**F**
	10	Route 128 northbound entering Rotary	A	A
		School St. entering Rotary	B	C
		Dory Rd. entering Rotary	C	B

* Boldface indicates undesirable level of service.

Table 2-5
Summary of Capacity Analyses
Existing (2001) Traffic Conditions
Route 128 Southbound Ramp Termini

City/Town	Exit	Ramp Terminus Location	Level of Service	
			AM	PM
Gloucester	12	Route 128 off-ramp at Ye Olde County Rd.	A	A
		Route 128 on-ramp at Causeway St.	A	A
	13	Route 128 off-ramp right-turn to Concord Rd.	A	A
		Route 128 off-ramp left-turn to Concord Rd.	B	B
		Concord Rd. to Route 128 on-ramp	A	A
	14	Route 128 off-ramp right-turn to Essex Ave.	A	B
		Route 128 off-ramp left-turn to Essex Ave.	B	B
		Essex Ave. to Route 128 on-ramp	A	A
Manchester by-the-Sea	15	Route 128 off-ramp right-turn to School St.	A	A
		Route 128 off-ramp left-turn to School St.	B	B
		School St. to Route 128 on-ramp	A	A
	16	Route 128 off-ramp right-turn to Pine St.	A	A
		Route 128 off-ramp left-turn to Pine St.	B	B
		Pine St. to Route 128 on-ramp	A	A
Wenham	17	Route 128 off-ramp right-turn to Grapevine Rd.	A	A
		Route 128 off-ramp left-turn to Grapevine Rd.	B	B
		Grapevine Rd. to Route 128 on-ramp	A	A
Beverly	18	Route 128 off-ramp right-turn to Essex St.	B	B
		Rotue 128 off-ramp left-turn to Essex St.	C	C
		Essex St. to Route 128 on-ramp	A	A
	19	Route 128 off-ramp right-turn to Brimbal Ave.	B	B
		Route 128 off-ramp left-turn to Brimbal Ave.	C	C
	20	Route 128 off-ramp to Route 1A northbound	C	D
		Route 128 off-ramp to Route 1A southbound	C	D

Table 2-6
Summary of Capacity Analyses
Existing (2001) Traffic Conditions
Route 128 Northbound Ramp Termini

City/Town	Exit	Ramp/Weaving Location	Level of Service	
			AM	PM
Beverly	20	Route 128 off-ramp to Route 1A southbound	D	**F***
		Route 128 off-ramp to Route 1A northbound	**E**	**F**
	19	Route 128 off-ramp to Brimbal Ave. southbound	B	B
		Route 128 off-ramp to Brimbal Ave. northbound	**F**	**F**
		Brimbal Ave. northbound to Route 128 on-ramp	A	A
		Route 128 on-ramp to Sohier Rd. southbound	**F**	**F**
	18	Route 128 off-ramp right-turn to Essex St.	B	B
		Rotue 128 off-ramp left-turn to Essex St.	**F**	**F**
		Essex St. to Route 128 on-ramp	A	A
Wenham	17	Route 128 off-ramp right-turn to Grapevine Rd.	A	A
		Route 128 off-ramp left-turn to Grapevine Rd.	B	B
		Grapevine Rd. to Route 128 on-ramp	B	B
Manchester	16	Route 128 off-ramp right-turn to Pine St.	A	A
by-the-Sea		Route 128 off-ramp left-turn to Pine St.	B	B
		Pine St. to Route 128 on-ramp	A	A
	15	Route 128 off-ramp right-turn to School St.	A	A
		Route 128 off-ramp left-turn to School St.	B	C
		School St. to Route 128 on-ramp	A	A
Gloucester	14	Route 128 off-ramp right-turn to Essex Ave.	B	B
		Route 128 off-ramp left-turn to Essex Ave.	B	C
		Essex Ave. to Route 128 on-ramp	A	A
	13	Route 128 off-ramp right-turn to Concord Rd.	A	A
		Route 128 off-ramp left-turn to Concord Rd.	B	B
		Concord Rd. to Route 128 on-ramp	A	A

* Boldface indicates undesirable level of service.

Figure 2-3

2001 Peak Hour Capacity Analysis
Exit 11
Route 128 @ Grant Circle, Gloucester

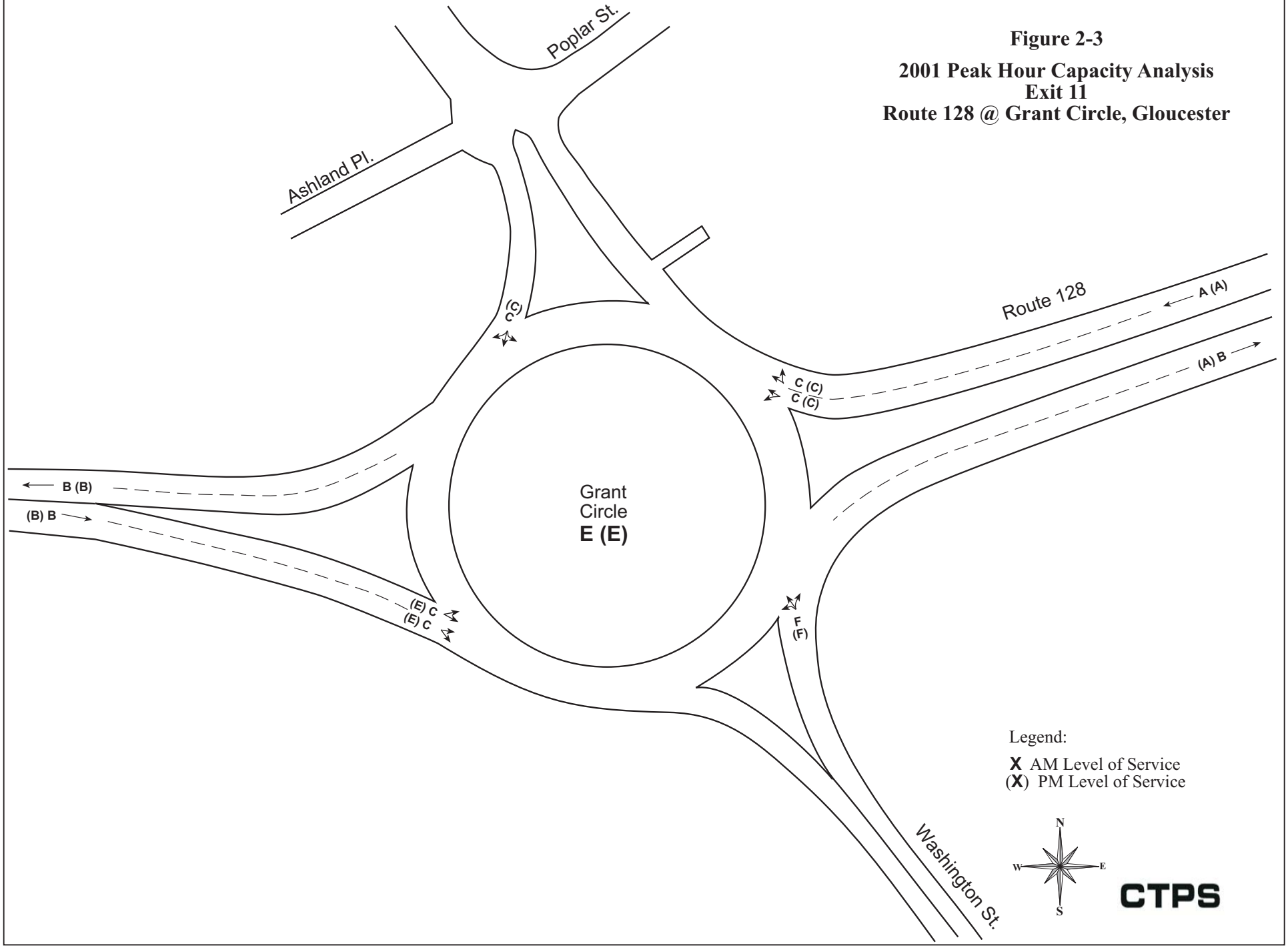


Figure 2-4

2001 Peak Hour Capacity Analysis
Exit 18
Route 128 @ Essex Street, Beverly

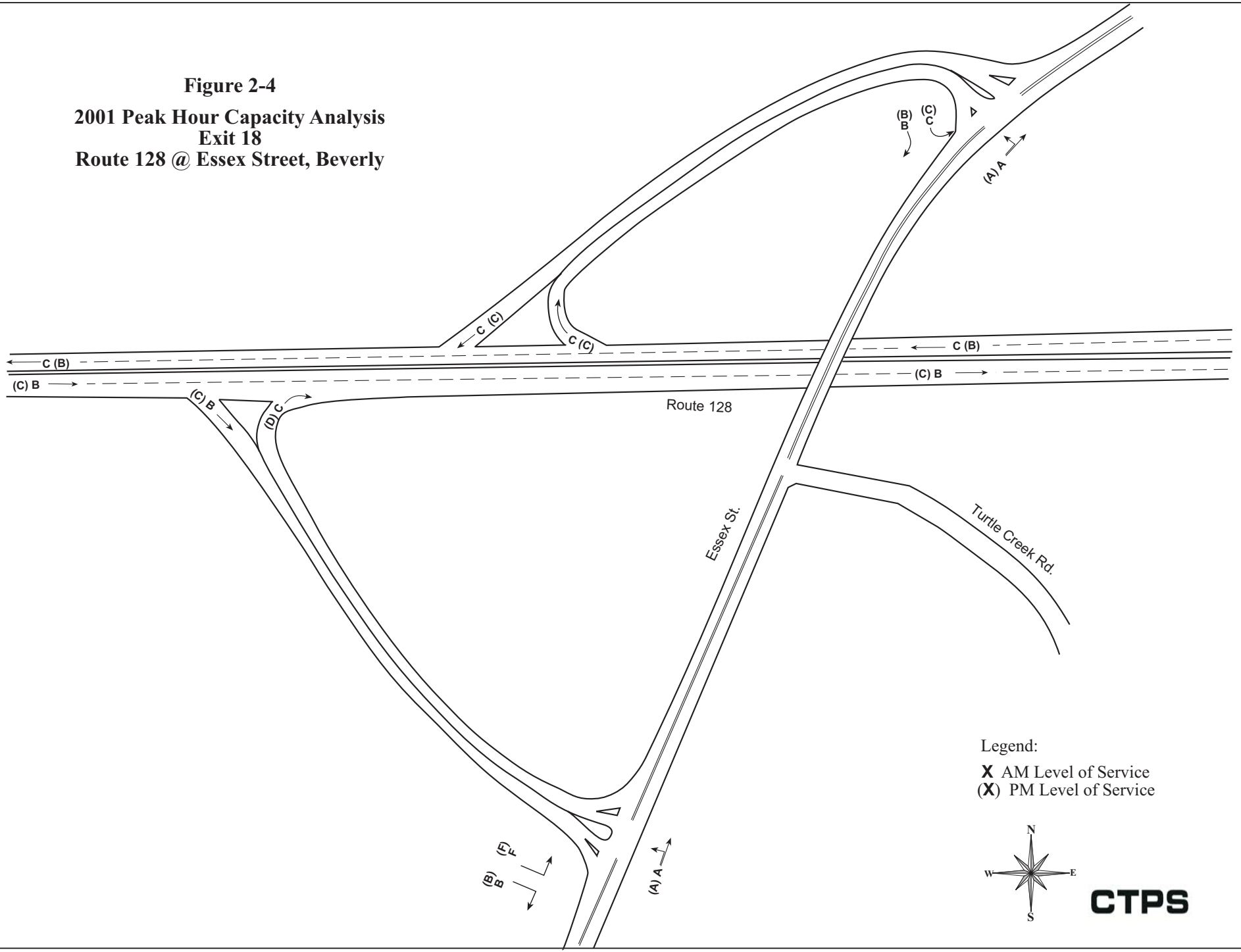


Figure 2-5

2001 Peak Hour Capacity Analysis
Exit 19
Route 128 @ Brimbal Avenue, Beverly

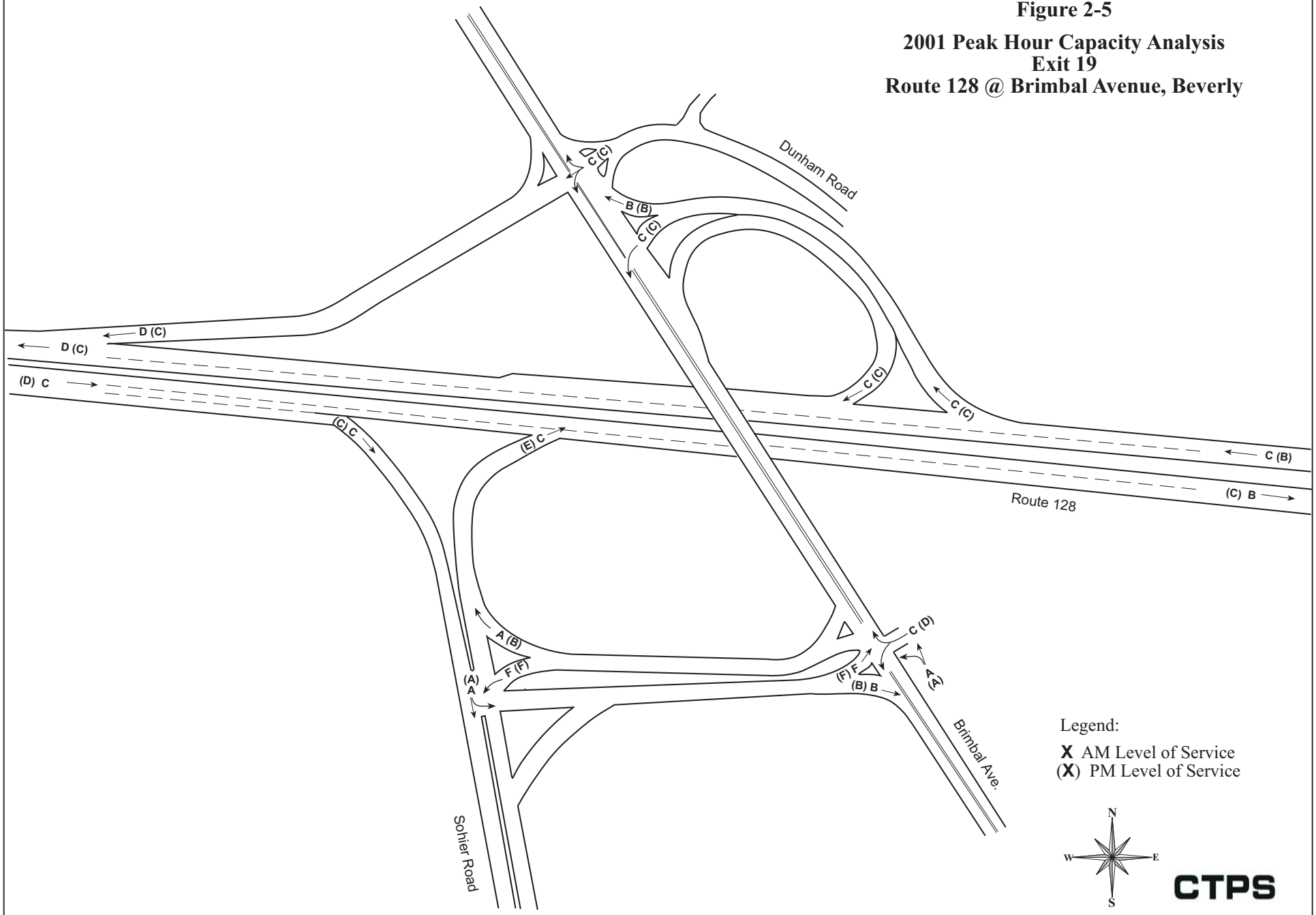
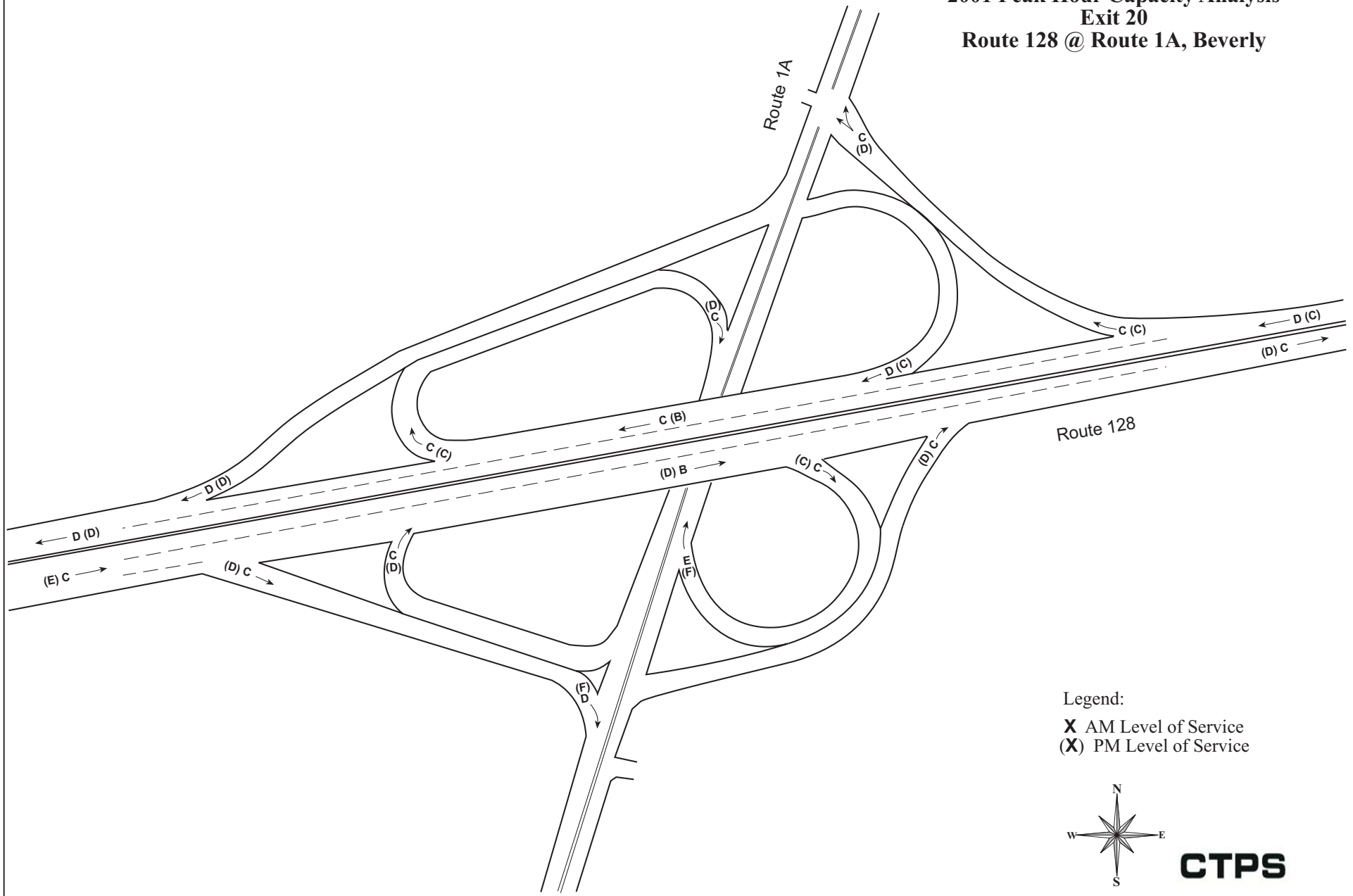


Figure 2-6

2001 Peak Hour Capacity Analysis
Exit 20
Route 128 @ Route 1A, Beverly



Legend:

X AM Level of Service
(**X**) PM Level of Service

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2.5 Interchange Geometry Review

While geometric elements are part of the input data for highway capacity analysis, the analysis does not explicitly address safety and operational concerns that are due to deficiencies of geometry. It is thus essential to review the geometry of the 11 interchanges despite the capacity analysis's showing that most locations on the interchanges operate at acceptable levels of service. Especially since this section of highway and the interchanges were designed about 50 years ago, they may need to be upgraded to current design standards.

Table 2-7 shows the existing ramp deceleration and acceleration distances at the interchanges along with the desirable distances. Sufficient deceleration length is needed to allow an exiting vehicle to leave the highway mainline safely and comfortably. What is sufficient depends upon the design speed of the mainline and the design speed of the controlling curve on the exit ramp. The existing deceleration lengths at the exit ramps of the interchanges from Exit 12 to Exit 20 are all insufficient to maintain safe and comfortable traffic operations. By the same token, sufficient acceleration length is needed for vehicles to enter the highway mainline safely and comfortably. The existing acceleration lengths at the entrance ramps of the interchanges from Exit 12 to Exit 20 are all far shorter than the desirable lengths and make traffic operations unsafe and uncomfortable.

In addition to deficient deceleration and acceleration lengths, many of the exits and entrances have ramps with turning curves that are too tight for vehicles to safely maintain sufficient speed when conducting highway merging and diverging maneuvers. These ramps with unsuitable turning radii are at Exits 12, 14, 15, 16, 17, 18, 19, and 20.

Finally, weaving distances at Exit 20 (Route 1A) in Beverly were examined. Weaving occurs, within an interchange or between two closely spaced interchanges, where two traffic streams, one making a merging maneuver and the other a diverging, cross. At Exit 20, the northbound weaving distance (between entrance ramp and exit ramp) is estimated to be about 350 feet, and the southbound weaving distance is estimated to be about 400 feet. Usually, the desirable length of a major weaving section is 1,150 feet or more[5]. The deficiencies of interchange geometry can further be learned in the analysis of crash data at various interchanges in the next chapter.

[5] P.6.37.0, Highway Design Manual, 1997 Edition, MassHighway.

Table 2-7
Overview of Interchange Ramp Deceleration and Acceleration Lengthes

Exit	Intersecting Street	Interchange Type	Rotary/ Ramp Exit Posted Speed	Deceleration Length at Exit Ramp		Acceleration Length at Entrance Ramp	
				Existing*	Desirable**	Existing*	Desiable***
10	Local Street	Rotary -Double Circulating Lane	25 MPH	NA	NA	NA	NA
11	Arterial	Rotary -Double Circulating Lane	25 MPH	NA	NA	NA	NA
12	Local Street	Irregular - Two adjacent Quadrants	NB: 25 MPH SB: 30 MPH	NB: < 150' SB: < 50'	NB: >= 475' SB: >= 440'	NB: < 100' SB: < 50'	NB: >= 980' SB: >= 980'
13	Arterial	Partial Cloverleaf - Two Diagonal Quadrants	NB: 25 MPH SB: 30 MPH	NB: < 200' SB: < 200'	NB: >= 475' SB: >= 440'	NB: < 300' SB: < 250'	NB: >= 980' SB: >= 980'
14	Arterial	Partial Cloverleaf - Two Diagonal Quadrants	NB: 25 MPH SB: 25 MPH	NB: < 350' SB: < 250'	NB: >= 475' SB: >= 475'	NB: < 250' SB: < 150'	NB: >= 980' SB: >= 980'
15	Arterial	Partial Cloverleaf - Two Diagonal Quadrants	NB: 30 MPH SB: 30 MPH	NB: < 350' SB: < 250'	NB: >= 440' SB: >= 440'	NB: < 200' SB: < 300'	NB: >= 870' SB: >= 870'
16	Local Street	Partial Cloverleaf - Two Adjacent Quadrants	NB: 25 MPH SB: 30 MPH	NB: < 250' SB: < 350'	NB: >= 475' SB: >= 440'	NB: < 250' SB: < 200'	NB: >= 980' SB: >= 870'
17	Arterial	Partial Cloverleaf - Two Diagonal Quadrants	NB: 30 MPH SB: 30 MPH	NB: < 300' SB: < 250'	NB: >= 440' SB: >= 440'	NB: < 300' SB: < 300'	NB: >= 870' SB: >= 870'
18	Arterial	Partial Cloverleaf - Two Adjacent Quadrants	NB: 30 MPH SB: 30 MPH	NB: < 400' SB: < 300'	NB: >= 440' SB: >= 440'	NB: < 350' SB: < 300'	NB: >= 870' SB: >= 870'
19	Arterial	Partial Cloverleaf - Three Quadrants, Two Loops	NB: 25 MPH SB: 25 MPH	NB: < 400' SB: < 350'	NB: >= 475' SB: >= 475'	NB: < 800' SB: < 350'	NB: >= 980' SB: >= 980'
20	Arterial	Full Cloverleaf	NB: 25/20 MPH SB: 25/20 MPH	NB: < 300'/350' SB: < 300'/400'	NB: >=475'/500' SB: >=475'/500'	NB: < 350'/450' SB: < 400'/350'	NB >=1080'/980' SB >=1080'/980'

Note: * Estimated from Aerial Photos
** See Table 6.1, Highway Design Manual, MassHighway, 1997 Edition
*** See Table 6.2, Highway Design Manual, MassHighway, 1997 Edition

3 ANALYSIS OF CRASH DATA

3.1 Data Collection and Analysis Method

This chapter describes the collection and analysis of crash data for the 11 interchanges in the study area. The goal of the crash data analysis was to determine whether the interchanges have any safety concerns and also to contribute to the identification of operational concerns. The crash data were tabulated and mapped by type and other characteristics and were searched for patterns. When crash patterns are related to the geometric and operational characteristics of the intersection, the causes of crashes may often be identified.

CTPS compiled accident statistics for the interchanges in the study area from the Massachusetts Registry of Motor Vehicles (RMV) database. The statistics covered the five-year period of 1996 to 2000. Table 3-1 summarizes the data by year, collision type and severity, day of week, and pavement conditions.

The interchanges with an average of 12 or more accidents per year were selected for further study: Exits 10, 11, and 14 in Gloucester and Exits 19 and 20 in Beverly. These five locations are all in the list of the top 1,000 high-crash locations in the state for the years 1997–99.[1] Because the RMV data do not tell the exact locations of the crashes or how they occurred, CTPS also collected police and operator reports from local police departments for the five selected interchanges. These accident reports were collected for the three-year period of 1999 to 2001.

For each of the selected interchanges, the each year's information extracted from the accident reports was summarized by total number of crashes, collision type, severity, day of week, pavement conditions, and weather conditions for each of the selected interchanges (Tables 3-2 to 3-6). Collision diagrams were also constructed for the five interchanges (Figures 3-1 to 3-5). These collision diagrams provided useful information for traffic safety and operation analysis. The analyses of the selected interchanges are discussed below. A summary of the findings of the study's crash data analysis concludes the chapter.

3.2 Analysis of Selected Locations

Route 128 at Blackburn Circle (Exit 10), Gloucester

This interchange is a rotary. The circulatory roadway width (nearly 60 feet) allows for two lanes of traffic. All approaches are single lane except for the two Route 128 approaches entering the rotary and the Route 128 southbound exiting the rotary, which are two-lane. The traffic volumes during the AM and PM peak hours are modest. Vehicle speeds are high due to the spacious layout of the rotary.

[1] *Top 1,000 High Crash Locations Report: 1997–1999*, Traffic Operations & Safety Unit, Massachusetts Highway Department, August 2002.

Table 3-1
Summary of Crash Data (1/1/96-12/31/00)*

Location		Exit 10	Exit 11	Exit 12	Exit 13	Exit 14	Exit 15	Exit 16	Exit 17	Exit 18	Exit 19	Exit 20/21
Year	**1996**	45	29	6	10	10	12	3	14	18	25	35
	1997	35	29	4	7	14	3	10	7	3	28	26
	1998	44	32	6	2	13	11	9	8	11	31	36
	1999	15	26	1	2	18	8	3	13	12	21	56
	2000	36	33	2	7	9	15	4	10	9	14	37
	Total	175	149	19	28	64	49	29	52	53	119	190
Collision Type	**Angle**	49	43	7	3	14	16	6	15	14	45	55
	Head-on	8	3	0	1	0	3	0	1	1	2	0
	Rear-end	57	65	2	13	24	3	7	7	11	39	95
	Unknown	61	38	10	11	26	27	16	29	27	33	40
	Total	175	149	19	28	64	49	29	52	53	119	190
Severity	**Property Damage**	108	102	11	13	34	26	15	31	36	60	108
	Personal Injury	63	43	8	14	28	22	12	21	16	57	73
	Fatality	1	0	0	0	0	0	0	0	0	1	0
	Other	3	4	0	1	2	1	2	0	1	1	9
	Total	175	149	19	28	64	49	29	52	53	119	190
Day of Week	**Monday-Friday**	141	111	13	20	47	33	17	42	43	102	170
	Saturday-Sunday	34	38	6	8	17	16	12	10	10	17	20
	Total	175	149	19	28	64	49	29	52	53	119	190
Pavement Conditions	**Dry**	101	111	14	17	36	29	18	21	35	94	145
	Wet	46	28	4	6	19	12	7	18	11	18	36
	Ice/Snow	21	5	1	4	6	6	3	13	6	4	5
	Unknown	7	5	0	1	3	2	1	0	1	3	4
	Total	175	149	19	28	64	49	29	52	53	119	190

*Source: Registry of Motor Vehicles. Data may include crashes that occured on the Route 128 mainline but were reported using the exits as references.

Although the RMV data show an average of 35 crashes per year from 1996 to 2000 at this location, CTPS could only obtain a total of 31 accident reports for the three-year period of 1999 through 2001. Possible reasons for this disparity are: (1) some crashes that occurred outside the rotary may have been included in the RMV data, as the rotary is the only obvious reference point in this section of Route 128; (2) some minor crashes may have been filed with the RMV but not the Gloucester Police Department.

As shown in Table 3-2, the majority of crashes were rear-end collisions and occurred under dry pavement conditions, in clear weather, and in daylight hours. Crashes happened somewhat more frequently in the morning peak hours than in other daylight hours. This is probably due to the heavy school traffic in the morning. None of the incidents involved personal injury.

Usually, rear-end collisions are due to congested traffic conditions, with their stop-and-go traffic flow. The sudden stops associated with vehicles trying to enter and exit a busy rotary could also lead to rear-end collisions. At this location, it appears that most of the rear-end crashes occurred when vehicles were entering the rotary from Route 128 and some when vehicles were entering from School Street (Figure 3-1). The speed at which the Route 128 vehicles travel may also be a factor.

Route 128 at Grant Circle (Exit 11), Gloucester

This rotary, unlike the one at Exit 10, endures heavy peak hour traffic, and it has a much smaller layout. The approaches are two-lane on Route 128 and one-lane on Washington Street. During the AM and PM peak hours, the entering approaches on Washington Street are frequently congested and traffic in the rotary is busy.

As shown in Table 3-3, a total of 125 crashes were recorded between 1999 and 2001 at this intersection. Rear-end collisions were the most common crash type, accounting for more than 50 percent of the crashes. Most of the crashes occurred on dry pavement, in clear weather, and during daylight hours. Crashes occurred more frequently in the morning and evening peak hours than in the other daylight hours.

As shown in Figure 3-2, many of these rear-end collisions happened when vehicles were entering the rotary. The reason is likely stop-and-go traffic conditions for the queuing vehicles. Angle collisions are mostly found between circulating vehicles and exiting vehicles, due to their speed difference. They also occur when vehicles entering from Washington Street collide with vehicles wanting to exit onto Route 128. In addition to the rotary accidents, there are a few broad-side collisions at Poplar Street and Washington Street. These collisions are due to the heavy traffic on Washington Street waiting to enter the rotary and not allowing the Poplar Street traffic to take a left turn onto Washington.

Route 128 at Essex Avenue (Exit 14), Gloucester

A total of 42 crashes were reported during 1999–2001 at this interchange (Table 3-4). Based on the reports obtained, just over half of the crashes were rear-end collisions. As shown in

Figure 3-3, the cause of the rear-end crashes may be vehicles exiting Essex Street and forcing themselves into Route 128 traffic. Most of the crashes occurred during clear weather and in daylight hours. However, about 40% happened under wet or ice/snow pavement conditions, and 12 out of the 42 crashes involved out-of-control vehicles.

The interchange is situated downhill from both Route 128 approaches. The vertical and horizontal curves along Route 128 may contribute to the high number of out-of-control vehicles and high crash rate under wet or icy/snow pavement conditions. High speeds on Route 128 in addition to the limited space for merging contribute to the difficulties Essex Street traffic experiences when entering the highway.

Route 128 at Brimbal Avenue (Exit 19), Beverly

According to the RMV data (Table 3-1), an average of 24 crashes per year were reported in 1996−2000. However, CTPS could only obtain a total of 12 accident reports from the state and local police departments. The collected reports indicate an even spread of rear-end collisions, angle collisions, and guard-rail collisions (Table 3-5). Most crashes occurred during clear weather, on dry pavement conditions, on weekdays in daylight hours.

The reason for the high number of angle collisions in this area is heavy turning movements onto Route 128. As shown in Figure 3-4, many crashes occurred in the vicinity of the merging area to Route 128 southbound from Brimbal Avenue. And some crashes occurred near the diverging area from Route 128 northbound to Sohier Road.

Route 128 at Dodge Street (Exit 20), Beverly

At this location, a total of 30 crashes, an average of 10 crashes per year, were reported in the three-year period of 1999 to 2001. There were 7, 9, and 14 crashes during the three years, respectively. The data indicate that more than 80% of the crashes were rear-end collisions (Table 3-6).

Many of the rare-end collisions took place on the Route 128 southbound stretch between the on and off-ramps of Route 1A (Figure 3-5). The main reasons for the high number of rear-end collisions are likely the heavy Route 128 traffic volumes extending from downstream and causing stop-and-go conditions, the speed difference between through traffic and entering and exiting traffic, and the weaving activities within limited roadway space. The collision diagram also indicates that a few out-of-control crashes happened on the ramps that have tight radii.

3.3 Summary of Findings

The crash data at the 11 interchanges of Route 128 in the study area were examined. Five interchanges, Exits 10,11, 14, 19, and 20, were selected for further study. At Blackburn Circle (Exit 10), about 10 crashes were reported per year. This level is not considered high for a rotary where complicated maneuvers, such as decelerating, accelerating, merging, and diverging, usually are required.

The crash rate at Grant Circle (Exit 11) is over 40 per year. High traffic volumes during the AM and PM peak hours and inappropriate maneuvers by drivers in the rotary contribute to the high crash rate at this location.

At Exit 14, the data show a relatively high number of out-of-control vehicles and a high number of crashes under wet or ice/snow pavement conditions. The roadway geometry and high traffic speeds may have contributed to these crashes.

At Exit 19, the RMV data show an average of 24 crashes yearly. The limited data from the local police department are insufficient to determine deficiencies at this interchange.

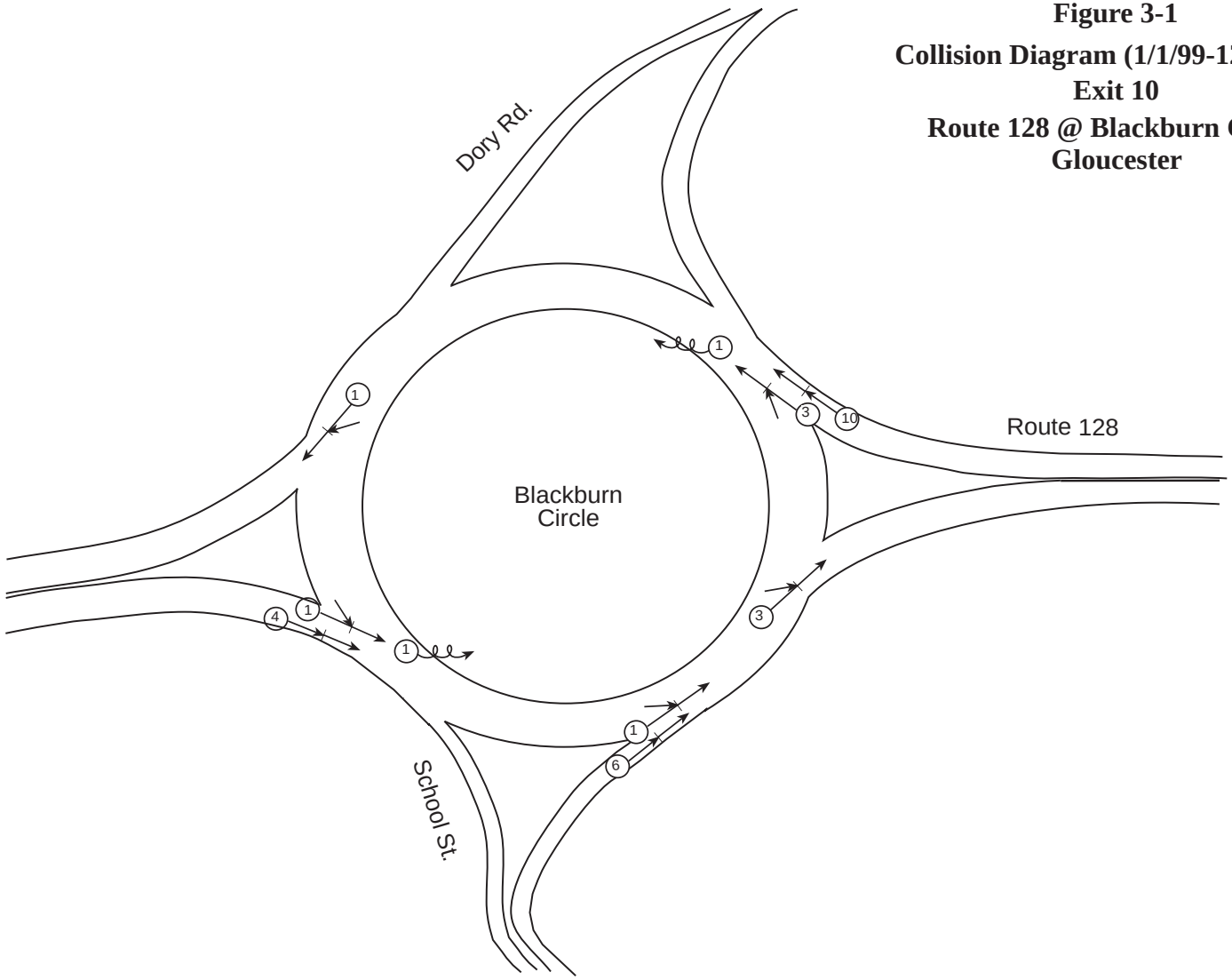
At Exit 20, most crashes happened in the section between the on- and off-ramps of the highway, especially in the southbound direction. Congested ramps and heavy merging/weaving operations in inadequate space may contribute to most crashes here. The analyses of the crash data for these interchanges indicate that geometric deficiencies and heavy peak hour traffic are major factors behind the high number of crashes.

Table 3-2
Summary of Crash Data (1/1/99 - 12/31/01)*
Route 128 at Blackburn Circle (Exit 10), Gloucester

Year		1999	2000	2001
Collision Type	**Rear End**	12	3	5
	Head On	0	0	0
	Angle	5	2	2
	Guard Rail	1	0	1
	Broad Side	0	0	0
	Pedestrian	0	0	0
	Total	18	5	8
Severity	**Property Damage**	18	5	8
	Personal Injury	0	0	0
	Fatality	0	0	0
	None	0	0	0
Time of Day	**7:00-9:00 AM**	4	0	4
	4:00-6:00 PM	3	0	2
	Other	11	5	2
Day of Week	**Mon-Fri**	14	5	8
	Sat-Sun	4	0	0
Pavement Conditions	**Dry**	16	4	6
	Wet	2	0	1
	Ice/Snow	0	1	1
Light Conditions	**Daylight**	14	4	7
	Dawn or Dusk	1	0	0
	Dark-No lights	1	0	1
	Dark-Lighted	2	1	0
Weather Conditions	**Clear**	16	4	7
	Foggy/Cloudy	1	0	0
	Rain	1	0	0
	Snow/Sleet	0	1	1
	Other	0	0	0

* Source : Gloucester Police Department

Figure 3-1
Collision Diagram (1/1/99-12/31/01)
Exit 10
Route 128 @ Blackburn Circle
Gloucester



SYMBOLS	TYPES OF COLLISIONS
(#) Number of Accidents	Rear End
Moving Vehicle	Head On
Backing Vehicle	Angle
Pedestrian	Out of Control
Fixed Object	Broad Side

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W E
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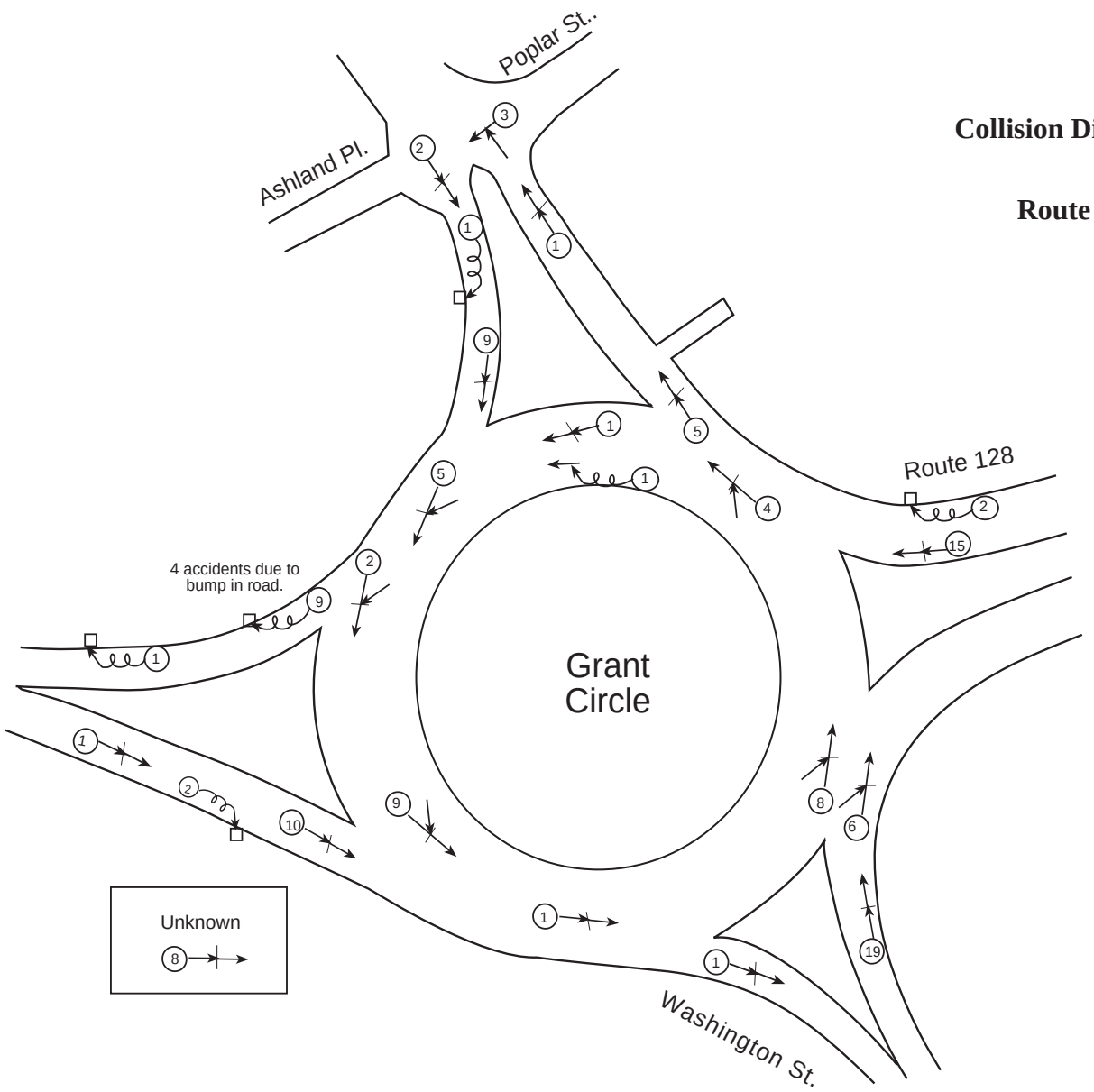
CTPS

Table 3-3
Summary of Crash Data (1/1/99 - 12/31/01)*
Route 128 at Grant Circle (Exit 11), Gloucester

Year		1999	2000	2001
Collision Type	**Rear End**	31	28	14
	Head On	0	0	0
	Angle	9	21	4
	Guard Rail	4	6	5
	Broad Side	0	2	1
	Pedestrian	0	0	0
	Total	44	57	24
Severity	**Property Damage**	29	32	15
	Personal Injury	1	9	0
	Fatality	0	0	0
	None	14	16	9
Time of Day	**7:00-9:00 AM**	9	10	4
	4:00-6:00 PM	10	15	6
	Other	25	32	14
Day of Week	**Mon-Fri**	30	41	17
	Sat-Sun	14	16	7
Pavement Conditions	**Dry**	37	44	19
	Wet	7	9	2
	Ice/Snow	0	4	3
Light Conditions	**Daylight**	39	47	17
	Dawn or Dusk	0	3	2
	Dark-No lights	1	2	0
	Dark-Lighted	4	5	5
Weather Conditions	**Clear**	37	46	22
	Foggy/Cloudy	2	1	1
	Rain	5	7	1
	Snow/Sleet	0	3	0
	Other	0	0	0

* Source: Gloucester Police Department

Figure 3-2
Collision Diagram (1/1/99-12/31/01)
Exit 11
Route 128 @ Grant Circle
Gloucester



SYMBOLS			TYPES OF COLLISIONS	
#	Number of Accidents	Pedestrian	Rear End	Out of Control
	Moving Vehicle		Head On	Broad Side
	Backing Vehicle	Fixed Object	Angle	

N
W E
S

CTPS

Table 3-4
Summary of Crash Data (1/1/99 - 12/31/01)*
Route 128 at Essex Avenue (Exit 14), Gloucester

Year		1999	2000	2001
Collision Type	**Rear End**	7	11	7
	Head On	0	0	0
	Angle	3	1	1
	Guard Rail	7	4	1
	Broad Side	0	0	0
	Pedestrian	0	0	0
	Total	17	16	9
Severity	**Property Damage**	15	11	5
	Personal Injury	2	4	2
	Fatality	0	0	0
	None	0	1	2
Time of Day	**7:00-9:00 AM**	2	5	0
	4:00-6:00 PM	3	4	0
	Other	12	7	9
Day of Week	**Mon-Fri**	12	12	4
	Sat-Sun	5	4	5
Pavement Conditions	**Dry**	12	5	8
	Wet	2	9	0
	Ice/Snow	3	2	1
Light Conditions	**Daylight**	15	11	7
	Dawn or Dusk	0	4	1
	Dark-No lights	1	1	1
	Dark-Lighted	1	0	0
Weather Conditions	**Clear**	12	6	8
	Foggy/Cloudy	1	0	0
	Rain	2	9	0
	Snow/Sleet	2	1	1
	Other	0	0	0

* Source: Gloucester Police Department

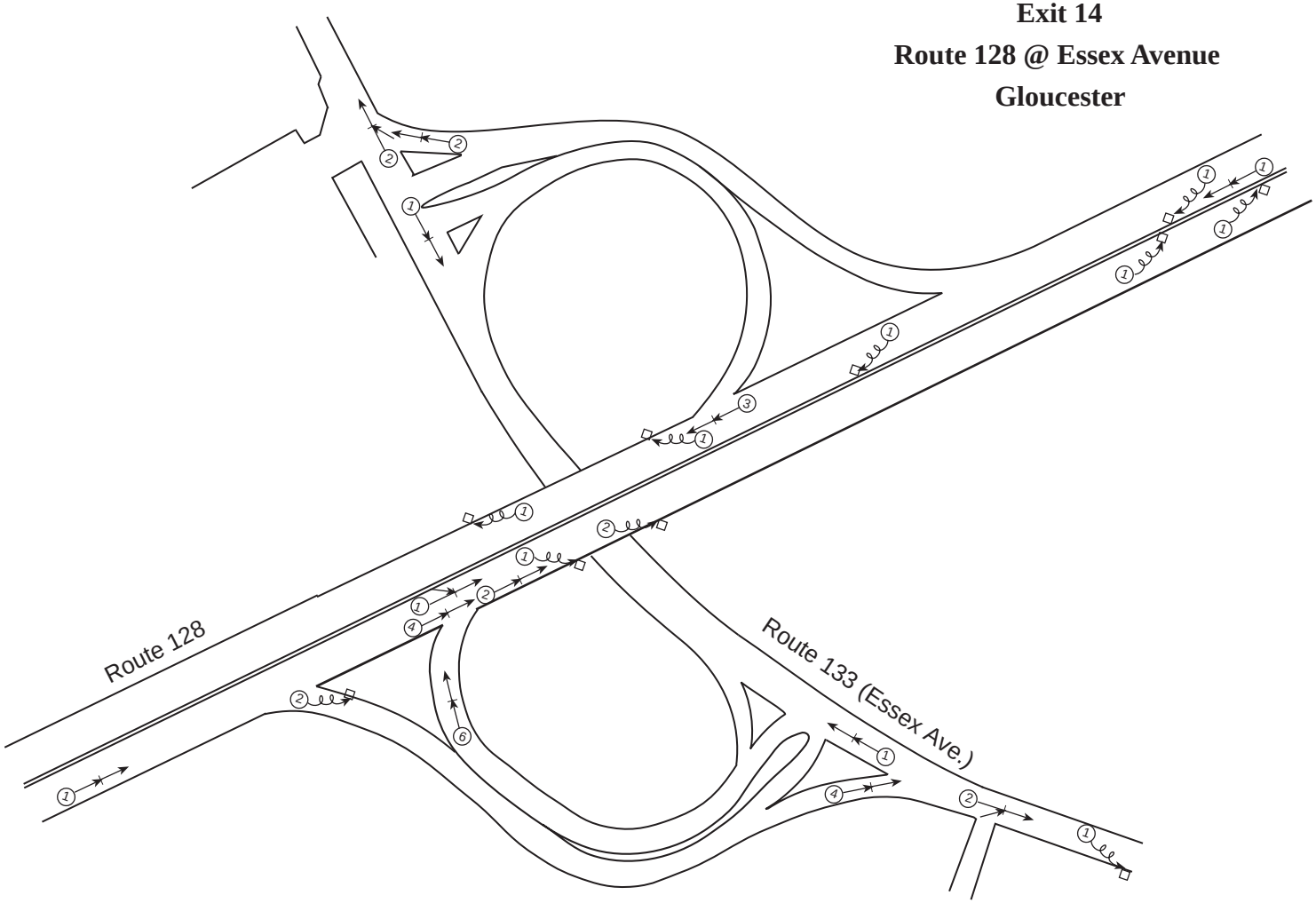
Figure 3-3

Collision Diagram (1/1/99-12/31/01)

Exit 14

Route 128 @ Essex Avenue

Gloucester



SYMBOLS	TYPES OF COLLISIONS
(#) Number of Accidents	Rear End
Moving Vehicle	Head On
Backing Vehicle	Angle
Pedestrian	Out of Control
Fixed Object	Broad Side

N W E S

CTPS

Table 3-5
Summary of Crash Data (1/1/99 - 12/31/01)*
Route 128 at Brimbal Avenue (Exit 19), Beverly

Year		1999	2000	2001
Collision Type	**Rear End**	2	2	0
	Head On	1	0	0
	Angle	2	1	0
	Guard Rail	1	1	1
	Broad Side	0	0	0
	Pedestrian	0	0	1
	Total	6	4	2
Severity	**Property Damage**	6	3	0
	Personal Injury	0	1	2
	Fatality	0	0	0
	None	0	0	0
Time of Day	**7:00-9:00 AM**	1	0	1
	4:00-6:00 PM	1	0	0
	Other	4	4	1
Day of Week	**Mon-Fri**	5	1	2
	Sat-Sun	1	3	0
Pavement Conditions	**Dry**	6	4	2
	Wet	0	0	0
	Ice/Snow	0	0	0
Light Conditions	**Daylight**	4	2	2
	Dawn or Dusk	0	0	0
	Dark-No lights	2	1	0
	Dark-Lighted	0	1	0
Weather Conditions	**Clear**	6	4	2
	Foggy/Cloudy	0	0	0
	Rain	0	0	0
	Snow/Sleet	0	0	0
	Other	0	0	0

* Source: Beverly Police Department

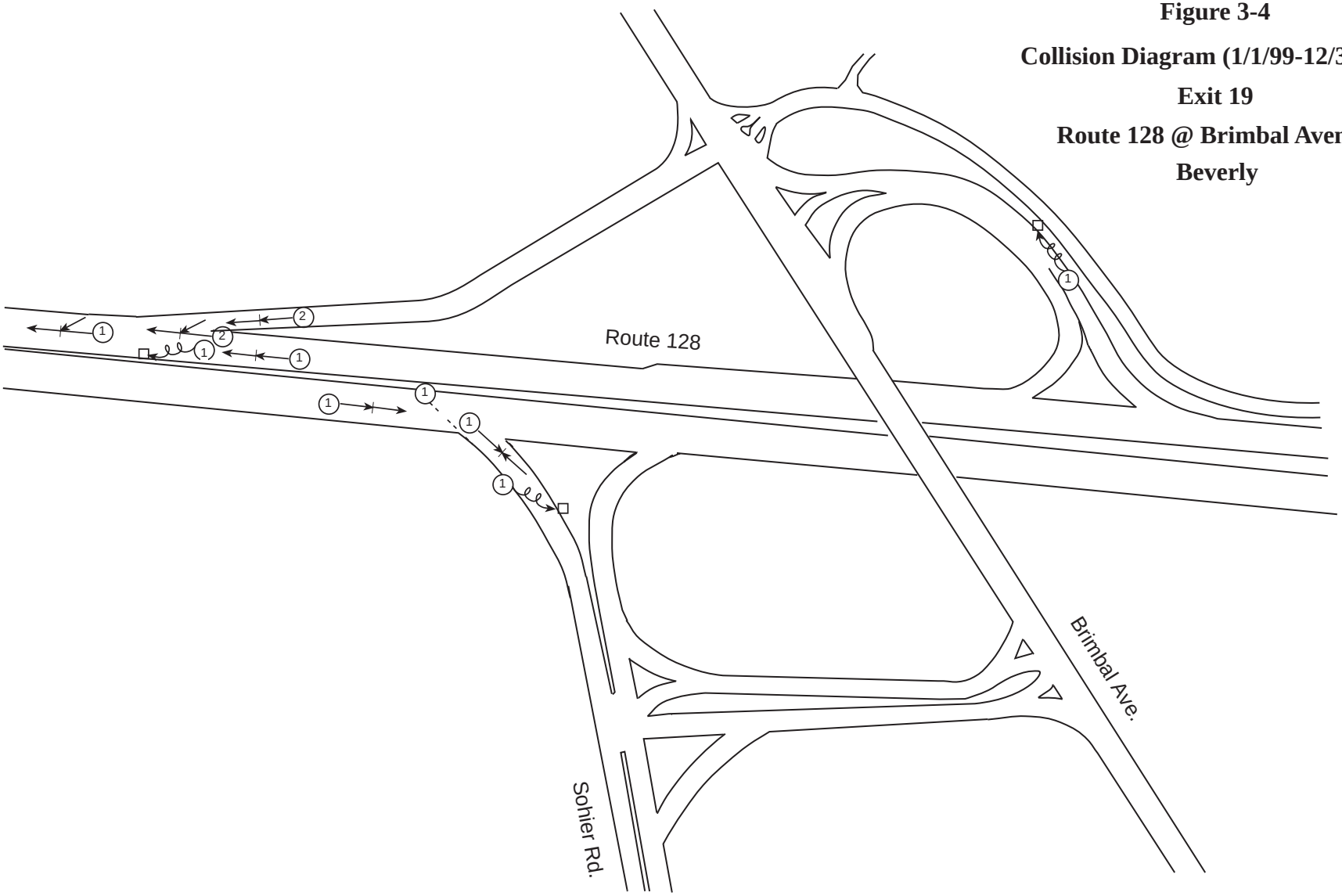
Figure 3-4

Collision Diagram (1/1/99-12/31/01)

Exit 19

Route 128 @ Brimbal Avenue

Beverly



SYMBOLS	TYPES OF COLLISIONS
# Number of Accidents	Rear End
Moving Vehicle	Head On
Backing Vehicle	Angle
Pedestrian	Out of Control
Fixed Object	Broad Side

N W E S

CTPS

Table 3-6
Summary of Crash Data (1/1/99 - 12/31/01)*
Route 128 at Route 1A (Exit 20), Beverly

Year		1999	2000	2001
Collision Type	**Rear End**	5	8	12
	Head On	0	0	0
	Angle	1	0	1
	Guard Rail	1	1	1
	Broad Side	0	0	0
	Pedestrian	0	0	0
	Total	7	9	14
Severity	**Property Damage**	7	5	9
	Personal Injury	0	4	5
	Fatality	0	0	0
	None	0	0	0
Time of Day	**7:00-9:00 AM**	0	4	6
	4:00-6:00 PM	3	4	2
	Other	4	1	6
Day of Week	**Mon-Fri**	6	7	10
	Sat-Sun	1	2	4
Pavement Conditions	**Dry**	5	8	14
	Wet	2	1	0
	Ice/Snow	0	0	0
Light Conditions	**Daylight**	5	7	11
	Dawn or Dusk	0	0	3
	Dark-No lights	2	1	0
	Dark-Lighted	0	1	0
Weather Conditions	**Clear**	5	8	13
	Foggy/Cloudy	2	0	1
	Rain	0	1	0
	Snow/Sleet	0	0	0
	Other	0	0	0

* Source: Beverly Police Department

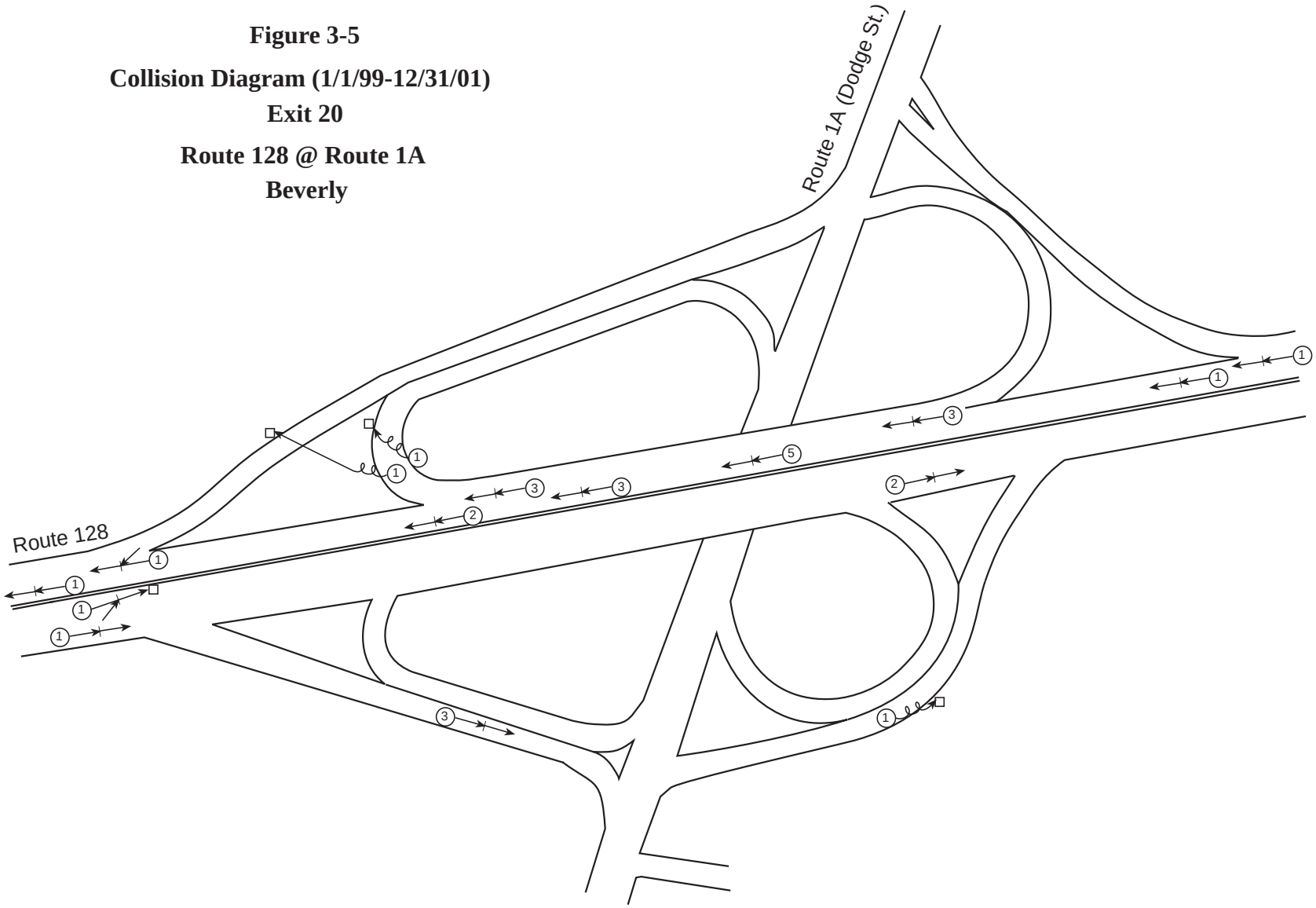
Figure 3-5

Collision Diagram (1/1/99-12/31/01)

Exit 20

Route 128 @ Route 1A

Beverly



SYMBOLS	TYPES OF COLLISIONS
(#) Number of Accidents	Rear End
Moving Vehicle	Head On
Backing Vehicle	Angle
Pedestrian	Out of Control
Fixed Object	Broad Side

N W E S

CTPS

4 FUTURE TRAFFIC CONDITIONS

4.1 Projection of Future Traffic Volumes

This chapter examines the future traffic conditions of the 11 interchanges based on the projected future traffic volumes under a no-build scenario. To project future travel demand in the study area, CTPS developed a transportation planning model set using the software TransCAD.[1] AM and PM peak period models were assembled for the base year 2001 and the future year 2025 (the peak periods were defined as 6:00−9:00 AM and 3:00−6:00 PM).

The basic inputs for the model set were network data, socioeconomic data, and traffic counts. CTPS maintains a regional transportation planning model set which contains data for all the roadways in eastern Massachusetts, including the study area. Attributes contained in these network data include roadway free-flow speed, number of lanes, distances between intersections, and other characteristics, such as whether the roadway operates as a one-way or two-way facility.

The socioeconomic data inputs were base year estimates and future year projections of population, households, and employment. The CTPS regional transportation model set contains these data at both the city/town level and the traffic analysis zone (TAZ) level for the 164 communities in eastern Massachusetts. The data were developed in 2000 by the Metropolitan Area Planning Council for the Boston Metropolitan Planning Organization's 2000−2025 Regional Transportation Plan Update.

Traffic counts are essential in the calibration of transportation models. In this study, the previously processed AM and PM peak period balanced traffic volumes (see Appendix B) were used for the calibration of the base year AM and PM regional model with a focus on the study area. The calibration was performed through comparing the model-assigned traffic volumes with the counts and then adjusting network configuration and attributes. The adjustments arrived at in this calibration were carried over to the future year for the construction of the future no-build network.[2]

Once the future no-build network was developed, traffic growth from base year to future year for various locations in the study area could be estimated through comparison of the base year and the future year traffic assignments. The future no-build peak period balanced traffic volumes were then obtained by adding the traffic growth to the base year peak period balanced volumes. The resulting volumes are shown individually for each of the 11 interchanges in Figures D-1 to D-11 in Appendix D.

[1] TransCAD Version 4.0 (2002), Caliper Corporation, Newton, Massachusetts

[2] The future no-build network was developed by means of the framework of 2025 CTPS regional network. "No-build" means no roadway additions or modifications in the study area. However, other areas in the network may have additions and modifications based on the assumptions of future transportation improvement projects in the Regional Transportation Plan 2000-2025.

The future no-build peak hour balanced traffic volumes were obtained by applying the study area peak hour factors (39.6% for AM and 36.0% for PM) to the future no-build peak period balanced volumes. The resulting volumes at various locations for each of the 11 interchanges are shown in Figures E-1 to E-11 in Appendix E. The projected peak hour volumes were used in the analysis of future no-build traffic conditions, which is discussed in the following sections.

Traffic volumes are projected to grow at relatively modest rates on the sections of Route 128 north of Exit 17 (Grapevine Road) in Wenham. Table 4-1 shows the 2001 and 2025 peak hour traffic volumes and amounts of growth for the Route 128 southbound mainline segments. Southbound is the peak direction in the morning. The growth between 2001 and 2025 ranges from about 100 to 300 vehicles (10−15% growth) for the segments north of Exit 17, to about 400 to 700 vehicles (20−25% growth) between Exit 17 and Exit 20, to over 950 vehicles (30% growth) for the segment south of Exit 20.

Table 4-2 shows 2001 and 2025 peak hour traffic volumes and amounts of growth for the Route 128 northbound mainline segments. Northbound is the peak direction in the evening. The growth between 2001 and 2025 ranges from about 100 to 325 vehicles (10−15% growth) for segments north of Exit 17 to about 400 to 750 vehicles (15−20% growth) for the segments south of Exit 17.

4.2 Route 128 Capacity Analysis

Based on the projected future traffic volumes, capacity analysis for future no-build conditions were performed. As in the capacity analyses for existing conditions, the analyses for future conditions were summarized at two levels: the entire Route 128 corridor and the individual interchanges. This section summarizes the capacity analyses for mainline segments, ramp junctions, rotaries, weaving areas on Route 128, and adjacent ramp termini. The next section addresses the analyses for the individual interchanges and focuses on those with capacity concerns.

Mainline Segments

Table 4-3 summarizes the results of capacity analyses for the Route 128 southbound mainline segments under future no-build conditions and also, for comparison, under existing conditions. The analyses indicate that all the segments north of Exit 19 will operate at acceptable levels of service under the future no-build scenario. However, the segment between Exit 18 and Exit 19 will operate at LOS D in the AM peak hour. This indicates that the projected traffic volume is approaching the highway's capacity. The segment between Exit 19 and Exit 20 will operate at LOS E in the AM peak hour. This indicates that the projected volume has reached the highway's capacity and traffic congestion is expected. The segment after Exit 20 (before Exit 21) will operate at LOS F in the AM peak hour. This indicates that the projected volume is over the highway's capacity and heavy traffic congestion is expected.

Table 4-4 summarizes the results of the capacity analyses for the Route 128 northbound mainline segments under the existing and future no-build conditions. The analyses indicate

that all the segments north of Exit 20 will operate at acceptable levels of service under the future no-build scenario. However, the segments between Exit 17 and Exit 20 will operate at LOS D in the PM peak hour. The segment south of Exit 20 will operate at LOS E in the AM peak hour and LOS F in the PM peak hour.

These results indicate the capacity of the Route 128 mainline in both directions south of Exit 19 will not be sufficient to handle the projected future traffic volumes. Mitigation measures should be considered for this section of highway to address future traffic conditions.

Ramp Junctions, Rotaries, and Weaving Areas

Table 4-5 summarizes the results of the analyses for the Route 128 southbound ramp junctions, rotaries, and weaving areas under the future no-build scenario and also gives the results for existing traffic conditions for comparison. In 2025, all the locations are projected to operate at acceptable levels of service (D or better) in both the AM and PM peak hours, except certain locations at Exits 11, 19 and 20. At Exit 11, Grant Circle in Gloucester, the LOS of the Washington Street eastbound approach in the AM peak hour is expected to deteriorate from C to F. At Exit 19, Brimbal Avenue in Beverly, the LOS at the junction of Route 128 and Brimbal Avenue southbound on-ramp in the AM peak hour is expected to deteriorate from D to E. At Exit 20, Route 1A in Beverly, the levels of service at the junctions of Route 128 with the Route 1A northbound on-ramp, Route 1A southbound off-ramp, and Route 1A southbound on-ramp are predicted to deteriorate from an acceptable level (C or D) to undesirable conditions (E or F).

Table 4-6 summarizes the capacity analyses for the Route 128 northbound ramps, rotary junctions, and weaving areas from Exit 20 to Exit 10 under the existing traffic conditions and under the future no-build scenario. As with the southbound projections, all of the locations are projected to operate in 2025 at acceptable levels of service in both the AM and PM peak hours except certain locations at Exits 11, 19, and 20. At Exit 11, the LOS of Route 128 entering the rotary in the PM peak hour is expected to deteriorate from E to F. At Exit 19, the LOS of the junction of Route 128 and the Brimbal Avenue off-ramp in the PM peak hour is expected to deteriorate from C to E. At Exit 20, the levels of service at the junctions of Route 128 and the Route 1A southbound off-ramp, Route 1A southbound on-ramp, and Route 1A northbound off-ramp are predicted to deteriorate from an acceptable level (C or D) to undesirable conditions (E or F).

Ramp Termini

Table 4-7 summarizes the capacity analyses for the southbound Route 128 ramp termini under existing conditions and the future no-build scenario. In 2025, all the locations are projected to operate at acceptable levels of service except one location at Exit 20. At that exit, the LOS of the terminus of Route 128 off-ramp to Route 1A northbound in the PM peak hour is expected to deteriorate from D to F. Table 4-8 summarizes the capacity analyses for the northbound Route 128 ramp termini under existing conditions and the future no-build scenario. In 2025, various locations at Exits 18, 19, and 20 are predicted to operate at undesirable levels of service. The analyses of these interchanges are further discussed in the next section.

Table 4-1
Summary of Peak Hour Traffic Volumes
Existing (2001) and Future (2025) No-Build Traffic Conditions
Route 128 Southbound Mainline Segments

	AM Peak Hour Volume				PM Peak Hour Volume			
Route 128 Mainline Location	**2001**	**2025**	**Growth**	**% Growth**	**2001**	**2025**	**Growth**	**% Growth**
Before Exit 10	1050	1130	80	8%	775	855	80	10%
Between Exit 10 and Exit 11	1000	1105	105	11%	980	1130	150	15%
Between Exit 11 and Exit 12	1600	1730	130	8%	1370	1565	195	14%
Between Exit 12 and Exit 13	1620	1765	145	9%	1365	1560	195	14%
Between Exit 13 and Exit 14	1615	1780	165	10%	1300	1495	195	15%
Between Exit 14 and Exit 15	1700	1900	200	12%	1375	1560	185	13%
Between Exit 15 and Exit 16	1900	2125	225	12%	1450	1640	190	13%
Between Exit 16 and Exit 17	2065	2350	285	14%	1580	1800	220	14%
Between Exit 17 and Exit 18	2140	2530	390	18%	1635	1870	235	14%
Between Exit 18 and Exit 19	2360	2800	440	19%	1805	2085	280	16%
Between Exit 19 and Exit 20	2940	3655	715	24%	2485	2905	420	17%
After Exit 20	3380	4345	965	29%	3005	3485	480	16%

Table 4-2
Summary of Peak Hour Traffic Voulumes
Existing (2001) and Future (2025) No-Build Traffic Conditions
Route 128 Northbound Mainline Segments

	AM Level of Service				PM Level of Service			
Route 128 Mainline Location	**2001**	**2025**	**Growth**	**% Growth**	**2001**	**2025**	**Growth**	**% Growth**
Before Exit 20	2570	2930	360	14%	3575	4320	745	21%
Between Exit 20 and Exit 19	2020	2360	340	17%	2830	3460	630	22%
Between Exit 19 and Exit 18	1500	1665	165	11%	2495	2930	435	17%
Between Exit 18 and Exit 17	1385	1510	125	9%	2275	2660	385	17%
Between Exit 17 and Exit 16	1295	1390	95	7%	2120	2445	325	15%
Between Exit 16 and Exit 15	1195	1280	85	7%	1940	2245	305	16%
Between Exit 15 and Exit 14	1160	1230	70	6%	1875	1960	85	5%
Between Exit 14 and Exit 13	1220	1290	70	6%	1630	1885	255	16%
Between Exit 13 and Exit 12	1315	1390	75	6%	1660	1900	240	14%
Between Exit 12 and Exit 11	1315	1395	80	6%	1650	1885	235	14%
Between Exit 11 and Exit 10	1265	1330	65	5%	1120	1250	130	12%
After Exit 10	785	840	55	7%	1110	1235	125	11%

Table 4-3
Summary of Capacity Analyses
Existing (2001) and Future (2025) No-Build Traffic Conditions
Route 128 Southbound Mainline Segments

Route 128 Mainline Location	AM Level of Service		PM Level of Service	
	2001	2025	2001	2025
Before Exit 10	A	A	A	A
Between Exit 10 and Exit 11	A	B	A	B
Between Exit 11 and Exit 12	B	B	B	B
Between Exit 12 and Exit 13	B	B	B	B
Between Exit 13 and Exit 14	B	B	B	B
Between Exit 14 and Exit 15	B	C	B	B
Between Exit 15 and Exit 16	B	C	B	B
Between Exit 16 and Exit 17	C	C	B	B
Between Exit 17 and Exit 18	C	C	B	C
Between Exit 18 and Exit 19	C	D	B	C
Between Exit 19 and Exit 20	D	**E***	C	D
After Exit 20	D	**F**	D	D

* Boldface indicates undesirable level of service.

Table 4-4
Summary of Capacity Analyses
Existing (2001) and Future (2025) No-Build Traffic Conditions
Route 128 Northbound Mainline Segments

Route 128 Mainline Location	AM Level of Service		PM Level of Service	
	2001	2025	2001	2025
Before Exit 20	C	D	**E***	**F**
Between Exit 20 and Exit 19	C	C	D	D
Between Exit 19 and Exit 18	B	B	C	D
Between Exit 18 and Exit 17	B	B	C	D
Between Exit 17 and Exit 16	B	B	C	C
Between Exit 16 and Exit 15	B	B	C	C
Between Exit 15 and Exit 14	B	B	C	C
Between Exit 14 and Exit 13	B	B	B	B
Between Exit 13 and Exit 12	B	B	B	B
Between Exit 12 and Exit 11	B	B	B	B
Between Exit 11 and Exit 10	B	B	A	B
After Exit 10	A	A	A	A

* Boldface indicates undesirable level of service.

Table 4-5
Summary of Capacity Analyses
Existing (2001) and Future (2025) No-Build Traffic Conditions
Route 128 Southbound Ramp/Rotary Junctions and Weaving Sections

City/Town	Exit	Ramp/Rotary/Weaving Location	AM Level of Service		PM Level of Service	
			2001	2025	2001	2025
Gloucester	10	Route 128 southbound entering Rotary	A	A	A	A
		School St. entering Rotary	B	B	C	C
		Dory Rd. entering Rotary	C	C	B	B
	11	Route 128 southbound entering Rotary	C	C	C	C
		Washington St. westbound entering Rotary	**F***	**F**	**F**	**F**
		Washington St. eastbound entering Rotary	C	**F**	C	D
	12	Causeway St. off-ramp	B	C	B	B
		Old County Rd. on-ramp	C	C	B	B
	13	Concord Rd. off-ramp	C	C	B	B
		Concord Rd. on-ramp	B	B	B	B
	14	Essex Ave. off-ramp	C	C	B	B
		Essex Ave. on-ramp	C	C	B	B
Manchester by-the-Sea	15	School St. off-ramp	C	C	B	B
		School St. on-ramp	C	C	B	C
	16	Pine St. off-ramp	C	C	B	C
		Pine St. on-ramp	C	C	B	C
Wenham	17	Grapevine Rd. off-ramp	C	C	B	C
		Grapevine Rd. on-ramp	C	C	B	C
Beverly	18	Essex St. off-ramp	C	C	C	C
		Essex St. on-ramp	C	D	C	C
	19	Brimbal Ave. off-ramp	C	D	C	C
		Brimbal Ave. northbound on-ramp	C	D	C	D
		Brimbal Ave. southbound on-ramp	D	**E**	C	D
	20	Route 1A northbound off-ramp	C	D	C	D
		Route 1A northbound on-ramp	D	**E**	C	D
		Weaving section b/w on-ramp and off-ramp	C	D	B	C
		Route 1A southbound off-ramp	C	**E**	C	D
		Route 1A southbound on-ramp	D	**F**	D	D

* Boldface indicates undesirable level of service.

Table 4-6
Summary of Capacity Analyses
Existing (2001) and Future (2025) No-Build Traffic Conditions
Route 128 Northbound Ramp/Rotary Junctions and Weaving Sections

City/Town	Exit	Ramp/Rotary/Weaving Location	AM Level of Service		PM Level of Service	
			2001	2025	2001	2025
Beverly	20	Route 1A southbound off-ramp	C	D	D	**F***
		Route 1A southbound on-ramp	C	D	D	**E**
		Weaving section b/w on-ramp and off-ramp	B	C	D	**F**
		Route 1A northbound off-ramp	C	C	C	**F**
		Route 1A northbound on-ramp	C	C	D	D
	19	Brimbal Ave. off-ramp	C	C	C	**E**
		Brimbal Ave. on-ramp	C	C	**E**	**E**
	18	Essex St. off-ramp	B	B	C	D
		Essex St. on-ramp	C	C	D	D
Wenham	17	Grapevine Rd. off-ramp	B	B	C	D
		Grapevine Rd. on-ramp	B	B	C	C
Manchester by-the-Sea	16	Pine St. off-ramp	B	B	C	C
		Pine St. on-ramp	B	B	C	C
	15	School St. off-ramp	B	C	C	C
		School St. on-ramp	B	B	C	C
Gloucester	14	Essex Ave. off-ramp	B	B	B	C
		Essex Ave. on-ramp	B	B	C	C
	13	Concord Rd. off-ramp	B	B	C	C
		Concord Rd. on-ramp	B	B	C	C
	12	Craft's Rd. off-ramp	B	B	C	C
		Craft's Rd. on-ramp	B	B	C	C
	11	Route 128 northbound entering Rotary	C	B	**E**	**F**
		Washington St. eastbound entering Rotary	C	**F**	C	D
		Washington St. westbound enterning Rotary	**F**	**F**	**F**	**F**
	10	Route 128 northbound entering Rotary	A	A	A	A
		School St. entering Rotary	B	B	C	C
		Dory Rd. entering Rotary	C	C	B	B

* Boldface indicates undesirable level of service.

Table 4-7
Summary of Capacity Analyses
Existing (2001) and Future (2025) No-Build Traffic Conditions
Route 128 Southbound Ramp Termini

City/Town	Exit	Ramp Terminus Location	AM Level of Service		PM Level of Service	
			2001	2025	2001	2025
Gloucester	12	Route 128 off-ramp at Ye Olde County Rd.	A	A	A	A
		Route 128 on-ramp at Causeway St.	A	A	A	A
	13	Route 128 off-ramp right-turn to Concord Rd.	A	A	A	B
		Route 128 off-ramp left-turn to Concord Rd.	B	B	B	C
		Concord Rd. to Route 128 on-ramp	A	A	A	A
	14	Route 128 off-ramp right-turn to Essex Ave.	A	A	B	B
		Route 128 off-ramp left-turn to Essex Ave.	B	B	B	C
		Essex Ave. to Route 128 on-ramp	A	A	A	A
Manchester by-the-Sea	15	Route 128 off-ramp right-turn to School St.	A	A	A	B
		Route 128 off-ramp left-turn to School St.	B	C	B	C
		School St. to Route 128 on-ramp	A	A	A	A
	16	Route 128 off-ramp right-turn to Pine St.	A	A	A	A
		Route 128 off-ramp left-turn to Pine St.	A	A	A	A
		Pine St. to Route 128 on-ramp	A	A	A	A
Wenham	17	Route 128 off-ramp right-turn to Grapevine Rd.	A	A	A	B
		Route 128 off-ramp left-turn to Grapevine Rd.	B	C	B	C
		Grapevine Rd. to Route 128 on-ramp	A	A	A	A
Beverly	18	Route 128 off-ramp right-turn to Essex St.	B	B	B	B
		Rotue 128 off-ramp left-turn to Essex St.	C	C	C	C
		Essex St. to Route 128 on-ramp	A	A	A	A
	19	Route 128 off-ramp right-turn to Brimbal Ave.	B	B	B	B
		Route 128 off-ramp left-turn to Brimbal Ave.	C	D	C	C
	20	Route 128 off-ramp to Route 1A northbound	C	C	D	**F***
		Route 128 off-ramp to Route 1A southbound	C	C	D	D

* Boldface indicates undesirable level of service.

Table 4-8
Summary of Capacity Analyses
Existing (2001) and Future (2025) No-Build Traffic Conditions
Route 128 Northbound Ramp Termini

City/Town	Exit	Ramp/Weaving Location	AM Level of Service		PM Level of Service	
			2001	2025	2001	2025
Beverly	20	Route 128 off-ramp to Route 1A SB	D	**F***	**F**	**F**
		Route 128 off-ramp to Route 1A NB	**E**	**F**	**F**	**F**
	19	Route 128 off-ramp to Brimbal Ave. SB	B	**F**	B	**F**
		Route 128 off-ramp to Brimbal Ave. NB	**F**	**F**	**F**	**F**
		Brimbal Ave. NB to Route 128 on-ramp	A	A	A	B
		Route 128 on-ramp to Sohier Rd. SB	**F**	**F**	**F**	**F**
	18	Route 128 off-ramp right-turn to Essex St.	B	**F**	B	**F**
		Rotue 128 off-ramp left-turn to Essex St.	**F**	**F**	**F**	**F**
		Essex St. to Route 128 on-ramp	A	A	A	A
Wenham	17	Route 128 off-ramp right-turn to Grapevine Rd.	A	B	A	B
		Route 128 off-ramp left-turn to Grapevine Rd.	B	C	B	C
		Grapevine Rd. to Route 128 on-ramp	B	B	B	B
Manchester	16	Route 128 off-ramp right-turn to Pine St.	A	A	A	A
by-the-Sea		Route 128 off-ramp left-turn to Pine St.	B	B	B	B
		Pine St. to Route 128 on-ramp	A	A	A	A
	15	Route 128 off-ramp right-turn to School St.	A	B	A	B
		Route 128 off-ramp left-turn to School St.	B	C	C	C
		School St. to Route 128 on-ramp	A	A	A	A
Gloucester	14	Route 128 off-ramp right-turn to Essex Ave.	B	B	B	B
		Route 128 off-ramp left-turn to Essex Ave.	B	C	C	C
		Essex Ave. to Route 128 on-ramp	A	A	A	A
	13	Route 128 off-ramp right-turn to Concord Rd.	A	A	A	A
		Route 128 off-ramp left-turn to Concord Rd.	B	B	B	C
		Concord Rd. to Route 128 on-ramp	A	A	A	A

* Boldface indicates undesirable level of service.

4.4 Interchange Capacity Analysis

The above analyses indicate that Exits 11, 18, 19, and 20 have one or more locations with capacity concerns under the future no-build scenario. The expected levels of service for locations at each of these four interchanges are shown in Figures 4-1 to 4-4. This information is presented for locations at all 11 of the interchanges in Figures G-1 to G-11 in Appendix G.

Exit 11, Route 128 at Grant Circle, Gloucester

The capacity analysis shows that in the AM peak hour the Washington Street westbound approach will operate at LOS F. In the PM peak hour the Washington Street approaches will operate at LOS F and the Route 128 northbound approach will operate at LOS E (see Figure 4-1). It is expected that peak hour traffic congestion will become more intense and vehicles on Washington Street and Route 128 northbound will experience more delays at this interchange in the future.

Exit 18: Route 128 at Essex Street (Route 22), Beverly

All locations at this interchange will operate at acceptable levels of service except the termini of the Route 128 northbound off-ramp. Both the right-turning and left-turning approaches to Essex Street will operate at LOS of F in the AM and PM peak hours (see Figure 4-2). This terminus location is currently under a stop control. In the base year analysis, only the left-turning approach operates at LOS F. The future year analysis indicates that as traffic increases, right-turning vehicles will frequently be blocked by the increased queue and experience delays.

Exit 19: Route 128 at Brimbal Avenue, Beverly

Several locations at this interchange will operate at undesirable levels of service under the future no-build scenario. The two ramp terminus locations and one ramp junction location that operate at undesirable levels of service in the base year will experience even more delays. In addition, the Route 128 southbound mainline and the junction of Route 128 southbound and Brimbal Avenue southbound will operate at LOS E in the AM peak hour (see Figure 4-3). This indicates that volume will reach capacity at these locations, and delays are expected.

Exit 20: Route 128 at Route 1A, Beverly

This interchange will experience intense traffic congestion under the future no-build scenario. The capacity analyses indicate that all the locations at this interchange will operate at undesirable levels of service except the junction of the Route 1A northbound on-ramp with Route 128 northbound and the mainline section north of the junction (see Figure 4-4).

In summary, in the future (2025), if no major improvements are made, most locations at Exits 11, 19, and 20 are predicted to have major traffic operation concerns, with traffic volumes exceeding highway capacities. At Exit 18, the ramp termini from the Route 128 northbound off-ramp to Essex Street will not be able handle the projected traffic volume under the existing

stop control operation. The analyses at Exits 19 and 20 also indicate that the capacity of the Route 128 mainline (both directions) south of Exit 19 is not sufficient to handle the projected future traffic volumes. Mitigation measures should be considered for this section of highway and for these interchanges in order to accommodate future traffic conditions.

Figure 4-1

2025 Peak Hour Capacity Analysis
Exit 11
Route 128 @ Grant Circle, Gloucester

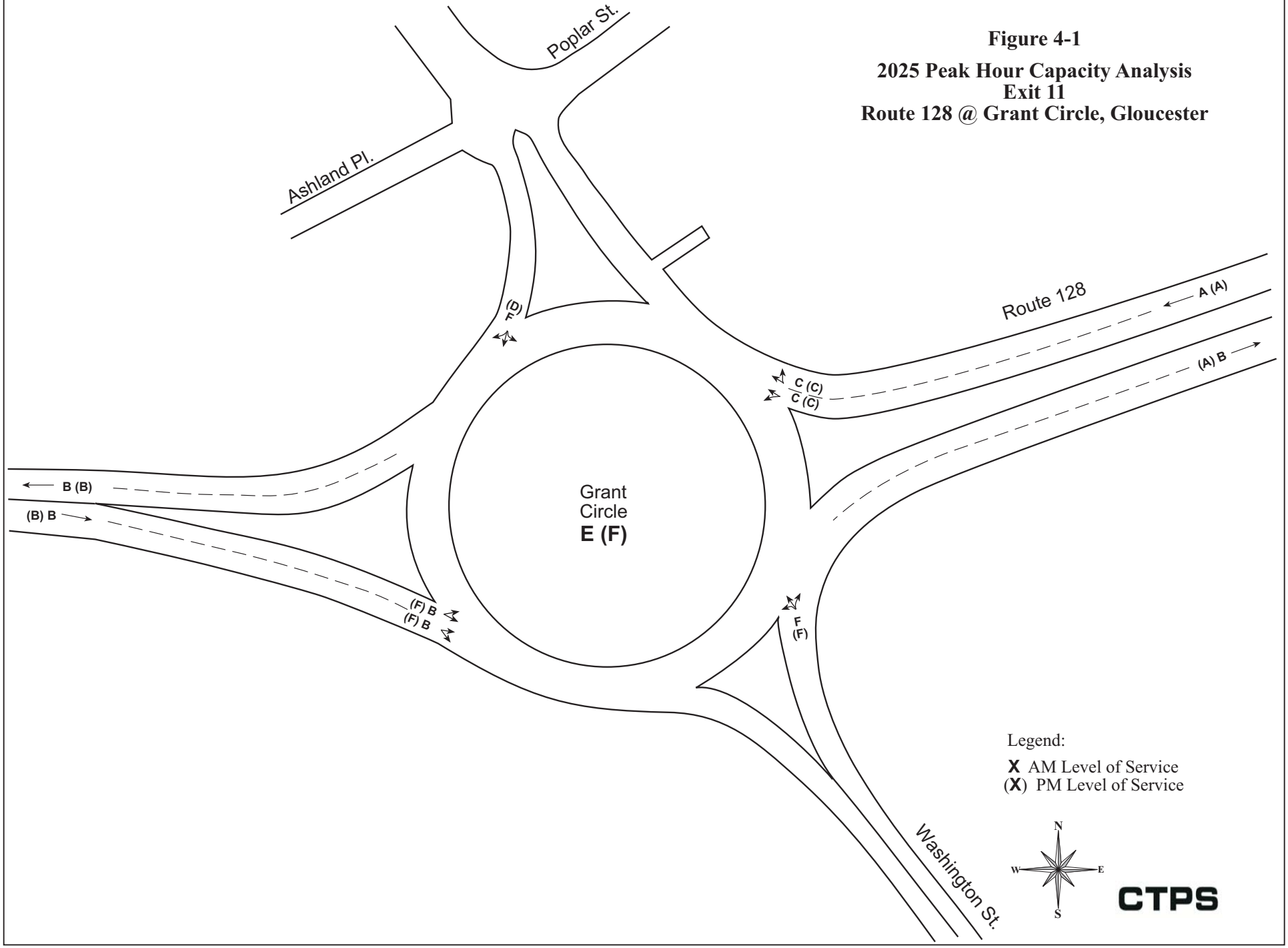


Figure 4-2

2025 Peak Hour Capacity Analysis
Exit 18
Route 128 @ Essex Street, Beverly

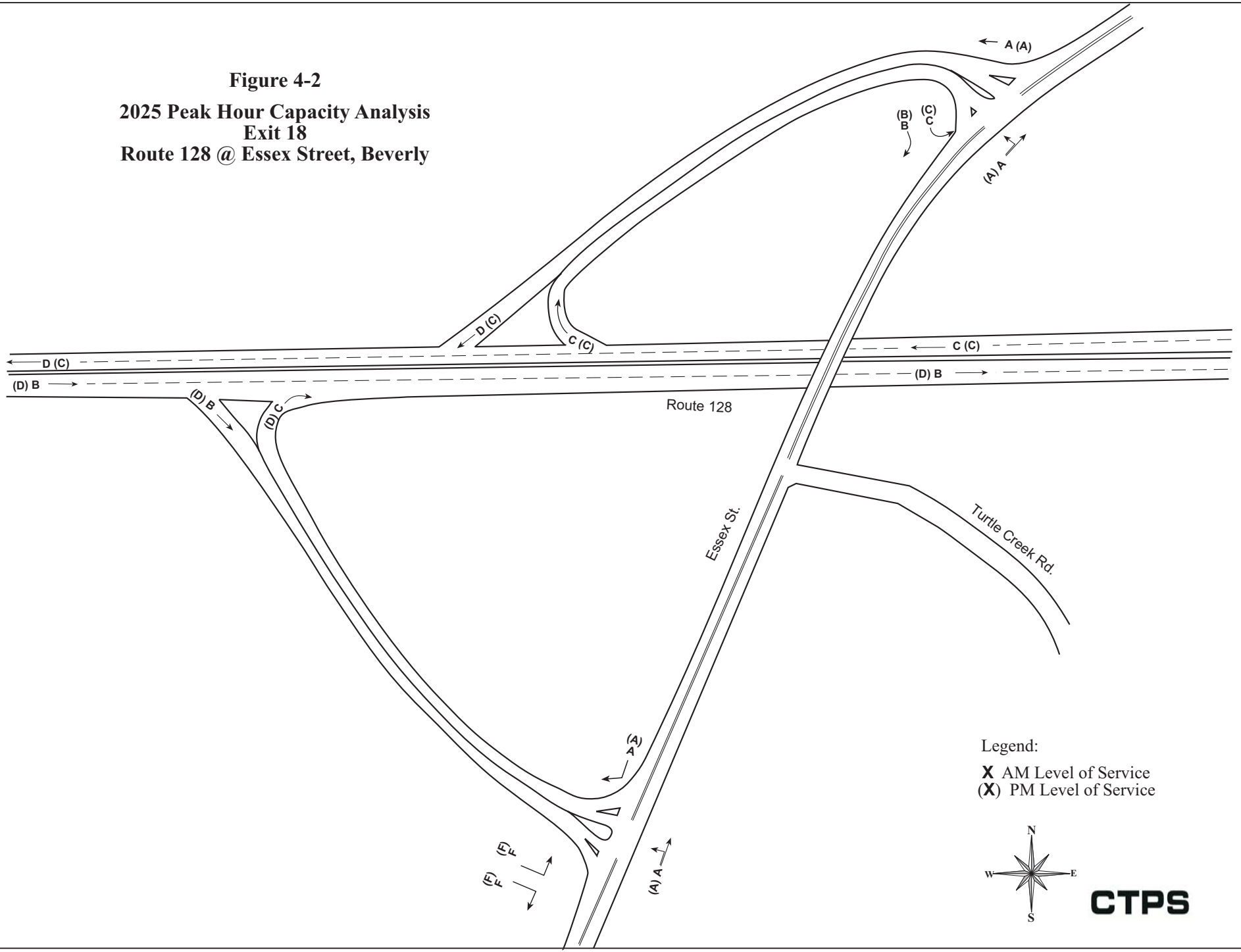


Figure 4-3

2025 Peak Hour Capacity Analysis
Exit 19
Route 128 @ Brimbal Avenue, Beverly

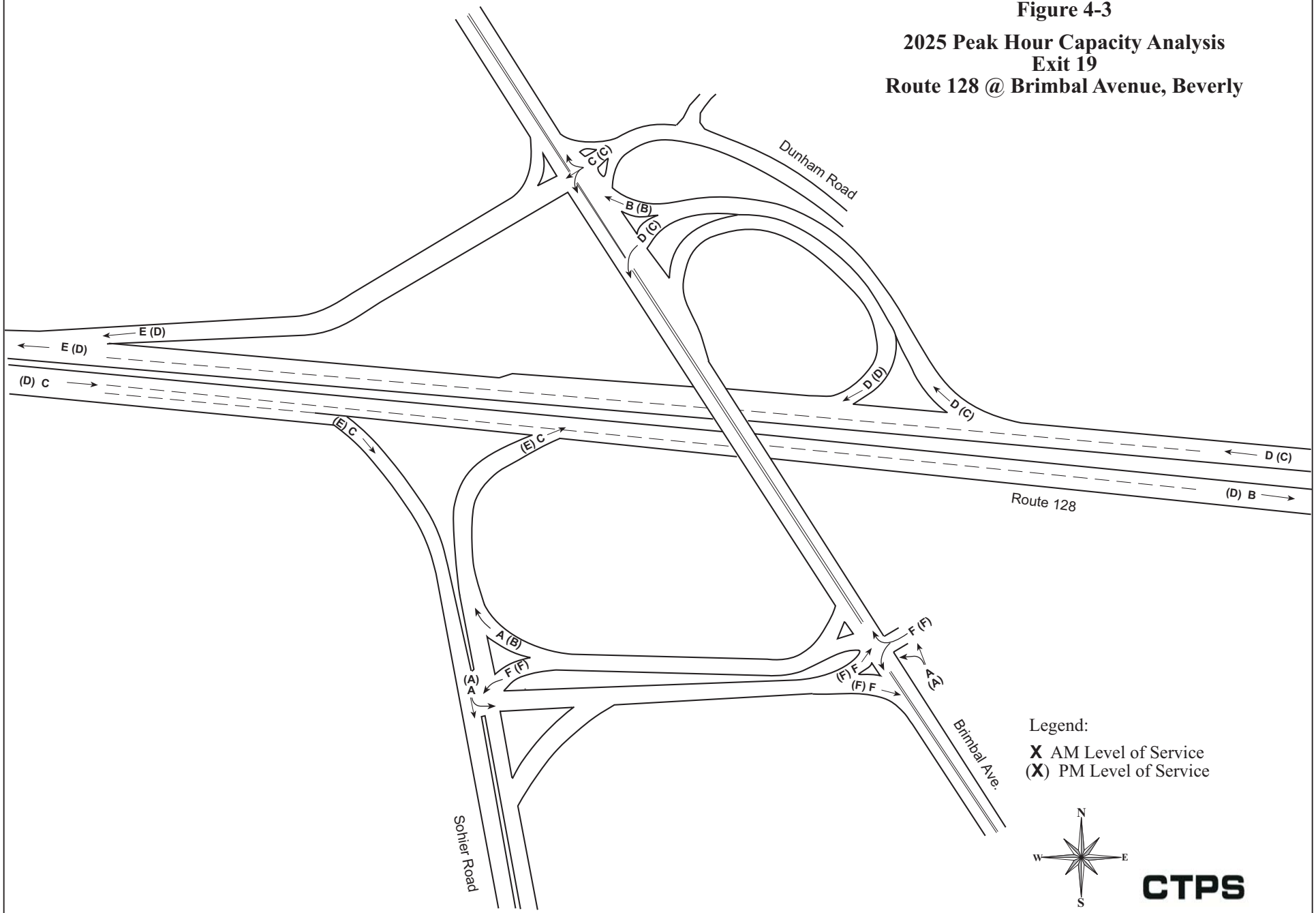
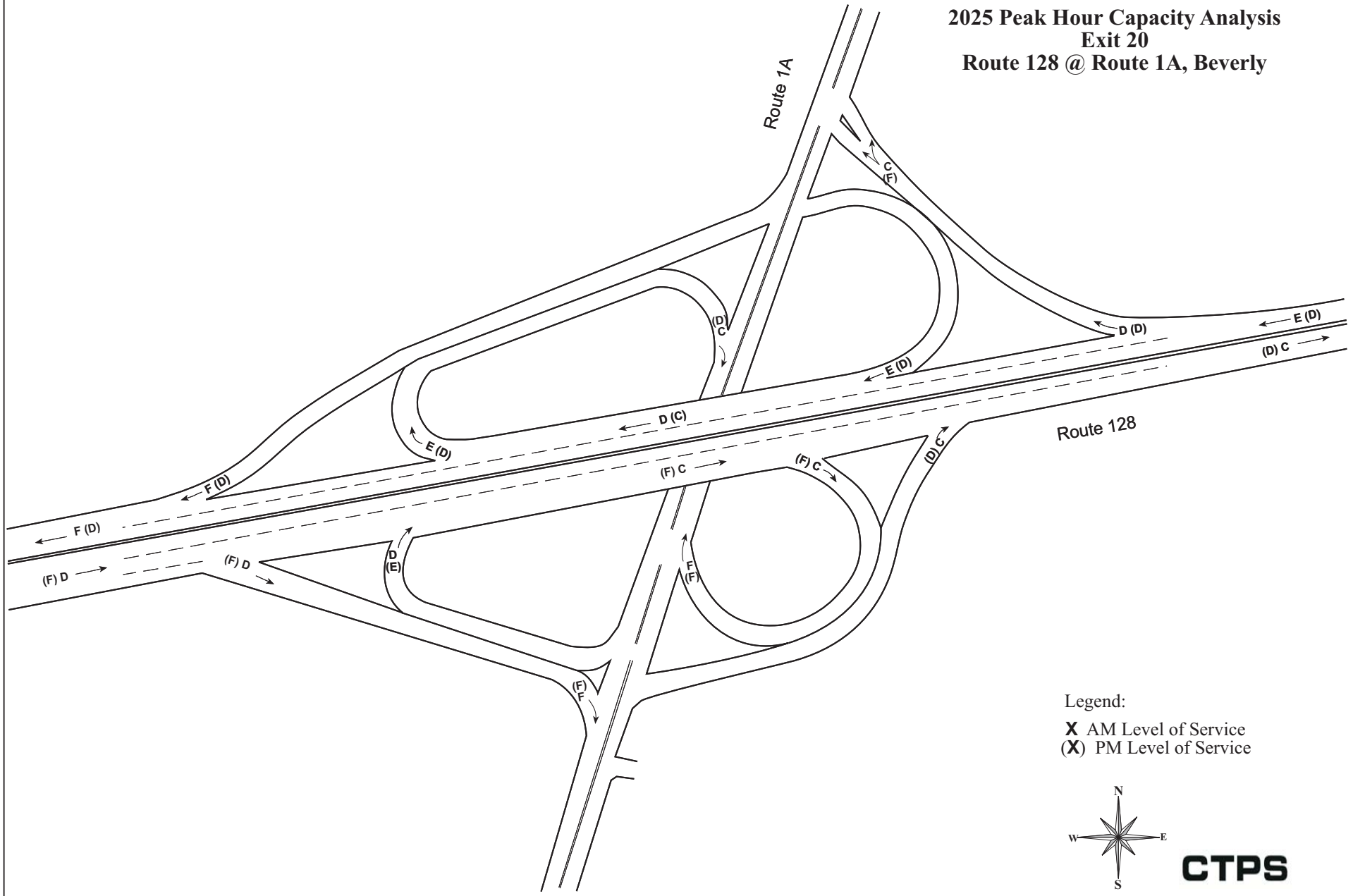


Figure 4-4

2025 Peak Hour Capacity Analysis
Exit 20
Route 128 @ Route 1A, Beverly



Legend:

X AM Level of Service
(**X**) PM Level of Service

N
W
E
S

CTPS

5 DEVELOPMENT OF CONCEPTUAL IMPROVEMENTS

5.1 Exit 10: Route 128 at Blackburn Circle, Gloucester

The layout of this rotary interchange is spacious, with two circulating lanes. The traffic volumes during the AM and PM peak hours are modest. The existing capacity analysis indicates that all the approaches at the rotary operate at an acceptable level of service (LOS). The future year analysis also indicates that the interchange will operate at an acceptable LOS although traffic is expected to grow by 10% in the AM peak hour and 15% in the PM peak hour. The crash data collected from the Gloucester Police Department do not indicate any major safety concerns.

Currently, the section of Route 128 northbound exiting the rotary has only one lane. This is the only section of the Route 128 between Exit 9 (Eastern Avenue in Gloucester) and Exit 20 (Route 1A in Beverly) in either direction that does not have two lanes to carry the highway traffic. The intersection of Route 128 and Eastern Avenue operates under traffic signal control. During peak hours of the summer season, traffic queues sometimes build from the intersection (Exit 9) to the vicinity of Exit 10.

It is suggested that one additional lane to be added in this section (see Figure 5-1). The addition will relieve the congestion at the Eastern Avenue intersection and reduce the conflict for vehicles exiting the rotary to Route 128 northbound.

5.2 Exit 11: Route 128 at Grant Circle, Gloucester

This is another of the two locations in the study area currently under rotary operation. Figure 5-2 shows the layout of the rotary and its surroundings. Unlike the previous interchange, this rotary carries heavy AM and PM peak hour traffic and in a more limited space. Currently, the Washington Street westbound approach is congested during both the AM and PM peak hours and Route 128 northbound vehicles are experiencing delays waiting to enter the rotary in the PM peak hour. Capacity analysis indicates that severe traffic congestion is expected in the future (2025).

Crash data analysis indicates a high number of crashes at this location. During the period from 1999 through 2001, the accident reports filed with the Gloucester Police Department show that on average more than 40 crashes occurred each year. The crash data analysis indicates that more crashes occurred during the peak hours than at other times of day.

The city is especially concerned with pedestrian safety at this location. A pedestrian safety study has been conducted at this location through a MassHighway Statewide Traffic Signal Contract[1]. Currently a crosswalk is located at the yield line of the Route 128 southbound entry to the rotary, with pedestrian crossing signs that are not very visible to the approaching vehicles. The study suggests a series of improvements including new and more visible

[1] *Grant Circle Rotary Pedestrian Safety Study*, BETA Group, Inc., June 2002

advance warning and pedestrian crossing signs, addition of flashing beacons on some of the proposed signs, and relocation of the crosswalk to about 60 feet to 70 feet north of the yield line of Route 128 southbound. The relocation of the crosswalk is aimed at shortening the crossing distance and reducing the conflict between pedestrians and circulating vehicles.

The existing traffic conditions at this location are undesirable during peak hours. The future conditions are projected to get worse under the no-build scenario. This location is complicated, traffic is heavy, and different modes are present. The area is further complicated by constraints, including residential and commercial developments and wetlands. It is suggested that a separate study be conducted for the long-term improvement of this location. The study should consider summer peak season conditions and improvements for all modes including pedestrians, bicycles and vehicles. Possible major improvement options include a grade separation and interchange with Washington Street, signalization with or without rotary demolition, and other measures.

5.3 Exit 12: Route 128 at Craft's Road, Gloucester

Highway capacity analysis does not indicate any major capacity concerns at this interchange under either existing or future traffic conditions. The Registry of Motor Vehicles (RMV) crash data show a lower number of crashes at this interchange than at other interchanges during 1996 through 2000 (see Table 3-1).

The interchange is a right-in/right-out type, with the Craft's Road bridge providing connections across Route 128. The bridge is currently undergoing major reconstruction. No improvements are proposed to the area near the bridge due to relatively low volumes and geometric restrictions from adjacent land uses and wetlands. It is suggested that the acceleration lane from the Ye Olde County Road on-ramp to Route 128 southbound and the deceleration lane from Route 128 northbound to Craft's Road be reconstructed (see Figure 5-3). The extensions will improve safety and comfort for merging and diverging traffic.

5.4 Exit 13: Route 128 at Concord Street, Gloucester

Highway capacity analysis shows no major capacity concerns at this interchange under either existing or future traffic conditions. The RMV crash data show a relative low number of crashes during the five-year period. However, the acceleration and deceleration distances for all the on- and off-ramps are very limited (see Table 2-7).

It is suggested that all the ramps be reconstructed (see Figure 5-4). The improvements include modifying the off-ramps in both Route 128 directions to allow for longer deceleration lanes and improved geometry. These improvements require small land takings that do not impact any homes. The two loop on-ramps should be maintained, with improved acceleration lanes. The improved acceleration lanes would probably require modifications to the existing Route 128 bridge over Concord Street. According to the city, major residential developments are expected in the near future in the area between Exit 13 and Exit 14. The recommended improvements will enhance safety and comfort for the interchange traffic. Extension of the

off-ramps, in addition to improving safety, provides more storage space between Route 128 and Concord Street to ease the traffic pressure on both roadways.

5.5 Exit 14: Route 128 at Essex Avenue (Route 133), Gloucester

Highway capacity analysis shows no major capacity concerns at this interchange under either existing or future traffic conditions. The RMV crash data show a relative high number of crashes in comparison with other similar locations. Analysis of the accident reports obtained from the Gloucester Police Department indicates that nearly half of all the crashes happened under wet or ice/snow pavement conditions and that many crashes involved out-of-control vehicles. The collision diagram (Figure 3-3) also indicates a repeated pattern of rear-end crashes in the merging areas.

The interchange is situated a location downhill from both directions on Route 128. The vertical and horizontal curves along Route 128 may contribute to the high number of out-of-control vehicles and of crashes under wet or ice/snow pavement conditions. High speeds on Route 128, in addition to merging space limitations, contribute to the difficulty for Essex Street traffic entering the highway.

It is suggested that the existing partial-cloverleaf configuration of the interchange be maintained, with improvements to the ramps and acceleration and deceleration lanes (see Figure 5-5). The Route 128 northbound off- and on-ramps would be improved to meet current design standards. This improvement would require extending outside the existing layout. However, examination of aerial photos indicates that the possible land-taking would not impact any homes and that the ramps would not be moved any closer to existing homes.

The Route 128 southbound off-ramp would be improved to allow for greater deceleration distance and a less tight radius. The southbound on-ramp would be maintained but its acceleration distance lengthened. The improvements to both acceleration lanes for the on-ramps would probably require modifications to the existing Route 128 bridge.

5.6 Exit 15: Route 128 at School Street, Manchester-by-the-Sea

Highway capacity analysis shows no major capacity concerns at this interchange under either existing or future traffic conditions. The RMV crash data show an average of about 10 crashes per year from 1996 to 2000.

It is suggested that the existing partial-cloverleaf interchange be maintained, with improvements made to the acceleration and deceleration lanes in both directions on Route 128 (see Figure 5-6). The northbound Route 128 off-ramp might require a land-taking to improve the deceleration lane and off-ramp curve radius. The other improvements would be within the current layout. The improved acceleration lanes on Route 128 could require lengthening the School Street bridge.

5.7 Exit 16: Route 128 at Pine Street, Manchester-by-the-Sea

Highway capacity analysis shows no major capacity concerns at this interchange under either existing or future traffic conditions. The RMV crash data show a relatively low number of crashes during the five-year period.

It is suggested that only the Route 128 southbound-off ramp be improved (see Figure 5-7). The existing half-cloverleaf interchange would be maintained. The southbound off-ramp deceleration lane would be improved within the existing layout. Other improvements are not recommended at this interchange due to relatively low traffic volumes and potential right-of-way impacts associated with improving the existing cloverleaf ramps.

5.8 Exit 17: Route 128 at Grapevine Road, Wenham

This interchange is located near Gordon College. Highway capacity analysis does not indicate any major capacity concerns at this interchange under either existing or future traffic conditions. The RMV crash data show an average of about 10 crashes per year from 1996 to 2000. The acceleration and deceleration distances for all the on- and off-ramps associated with this interchange are limited.

The improvement recommended for this interchange is to lengthen the acceleration and deceleration lanes on Route 128 northbound and southbound (see Figure 5-8). The existing partial cloverleaf ramps would be maintained. The extending of the acceleration lanes in both the northbound and southbound directions would probably require modifications of the Grapevine Road bridge. Also the relocation of Route 128 southbound off-ramp could impact the tennis courts associated with Gordon College. In addition to the improvement to the interchange geometry, improvements to the pedestrian walkways, sidewalks, and crosswalk are recommended in this area.

5.9 Exit 18: Route 128 at Essex Street (Route 22), Beverly

The RMV crash data show an average of about 10 crashes per year from 1996 to 2000. Highway capacity analysis indicates that all locations at this interchange operate at acceptable levels of service except one. The approach from Route 128 northbound to Essex Street northbound operates at LOS F under both existing and future traffic conditions. The same approach to Essex Street southbound is projected to deteriorate from LOS B to F in the future. In other words, both right-turning vehicles and left-turning vehicles will experience major delays at the terminus.

The proposal for this interchange is to improve the acceleration and deceleration lanes on Route 128 northbound and construct half-diamond interchange ramps on the Route 128 southbound side (see Figure 5-9). The Route 128 northbound modifications would increase the deceleration lane to Old Essex Road and improve the radius of the ramp. The improvement would require further investigation of impact on the residences near the ramp diverging area. Also the acceleration lane to Route 128 northbound would be lengthened.

The improvement would require further investigation to determine whether the bridge abutment would prohibit possible widening for the acceleration lane.

On the southbound side, the proposed half-diamond ramps would improve the acceleration and deceleration lanes. The proposed ramp intersection would be unsignalized. This improvement would require that the existing Old Essex Street be made a local street to provide access to the nearby residential developments and separate them from the highway system.

As to the capacity concern at the terminus from Route 128 northbound to Essex Street, it is suggested that the city monitor the location periodically. At present, although sometimes as many as 15 to 20 vehicles line up during the PM peak hour, the queue is able to dissipate within one or two minutes. However, in the future the Route 128 mainline operation may be affected if the queue extends all the way to the diverging point. In that case, a traffic signal or other mitigation measures should be considered at the terminus.

5.10 Exit 19: Route 128 at Brimbal Avenue, Beverly

This partial cloverleaf interchange carries much more traffic than most of the other interchanges in the study area. The highway capacity analyses indicate that many locations, including ramp junctions and ramp termini, will operate at undesirable levels of service in the future. The RMV crash data show a relatively high number of crashes during the period 1996- to 2000.

The city has hired a consultant to conduct a study to investigate the feasibility of reconstruction this interchange.[2] It aims to relieve geometric deficiencies, improve safety, increase capacity, and provide access to the Norwood Pond development area. The study will be evaluated by MassHighway for any recommended improvements. Therefore no improvements are suggested by this study. The existing layout of the interchange is shown in Figure 5-10.

5.11 Exit 20: Route 128 at Route 1A, Beverly

This is a major interchange where Route 128 meets Route 1A, a state highway running from Boston to the New Hampshire border. It is a substandard full cloverleaf interchange that carries heavy traffic during the AM and PM peak hours. Highway capacity analysis indicates that many locations, including mainline segments, ramp junctions, ramp termini, and a weaving section, will operate at undesirable levels of service in the future. The RMV crash data show a high number of crashes during the period 1996 to 2000. Heavy traffic and geometric deficiencies such as tight ramps and short merging/diverging distances are all factors in the high number of crashes.

[2] *Conceptual Design and Feasibility Study for the Reconstruction of Route 128 Overpass/Interchange 19 (Brimbal Avenue) in the City of Beverly, Massachusetts*, prepared by Bayside Engineering in association with Edwards and Kelcey, December 26, 2001.

The surrounding areas are well developed and available space for expanding the interchange is limited. Residential and commercial developments are well established on both sides of Route 1A. Near the interchange there are several traffic signals along Route 1A. The traffic operations on Route 1A are highly correlated with those on Route 128, and both depend on smooth operations at the interchange. It is essential to consider all these factors and to expand the study area beyond the immediate vicinity of the interchange.

It is suggested that a further study be conducted of this complicated interchange. Improvement alternatives should be evaluated, with a thorough review of impacts from different factors. At this preliminary stage, two examples of possible improvement concepts are offered. The first is to eliminate the existing substandard cloverleaf interchange ramps and replace them with a diamond interchange (see Figure 5-11). This would improve both the acceleration and deceleration lanes on Route 128. The improvement would necessitate the construction of two signalized intersections at the ramp junction with Route 1A. Also, the existing Route 128 bridge over Cabot Street (Route 97) would need to be widened to accommodate the new acceleration and deceleration lanes. The proposed improvement could be constructed within the existing layout.

The second example is to eliminate the two tight loop ramps on the west of Route 1A and to lengthen the acceleration and deceleration distances for the ramps (see Figure 5-12). Route 128 access by the two eliminated ramps would be provided through openings at the on-ramp to Route 128 northbound and at the off-ramp from Route 128 southbound. The existing Route 128 bridge over Route 97 would possibly need to be widened to accommodate the new acceleration and deceleration lanes.

Dory Rd
ROUTE 128
ROUTE 128
School House Rd
ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

Figure 5-1
Conceptual Improvements
Exit 10: Route 128 at Blackburn Circle
Gloucester

CTPS

Figure 5-2
Existing Interchange Layout
Exit 11: Route 128 at Grant Circle
Gloucester

CTPS

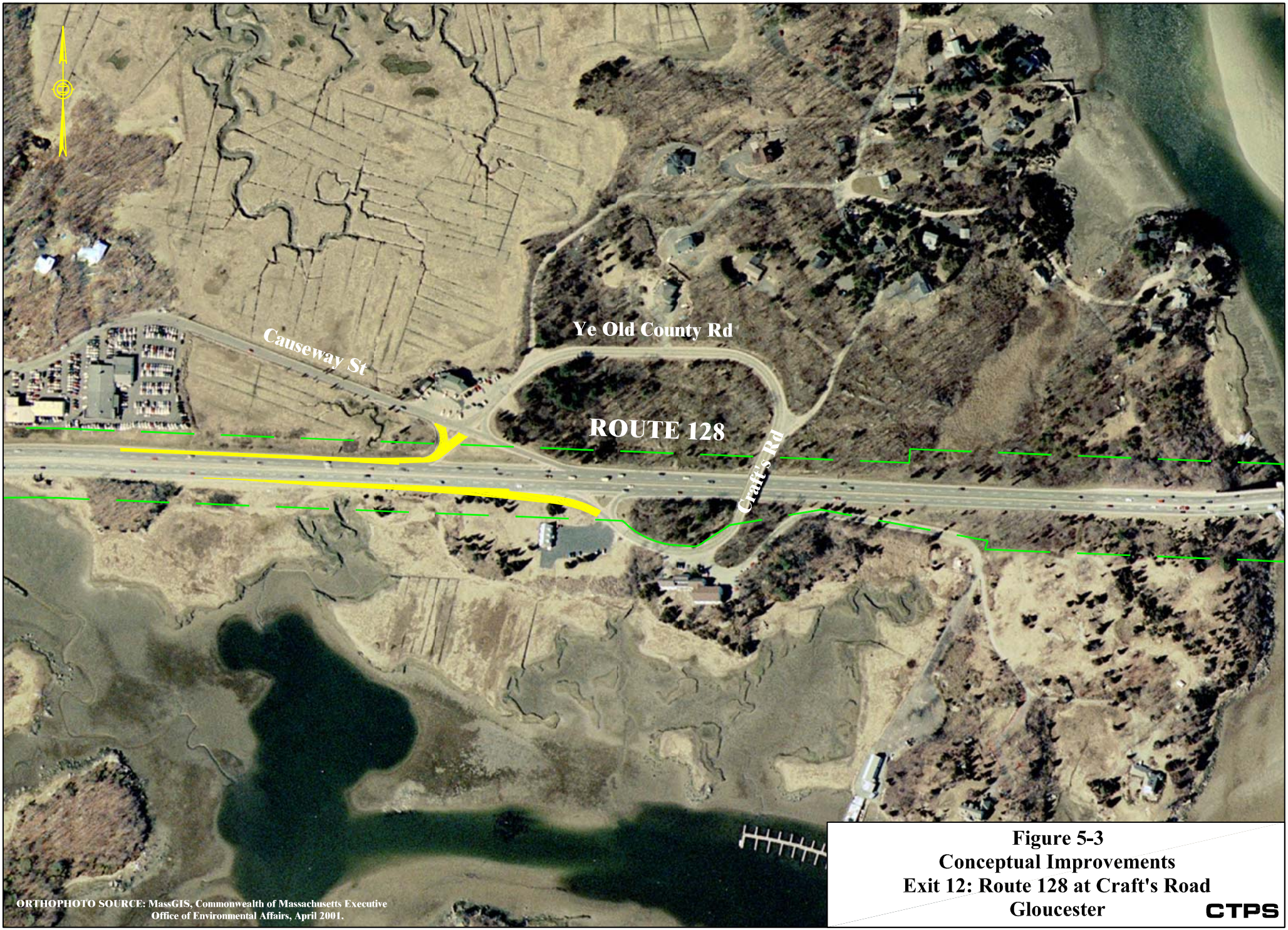

Causeway St
Ye Old County Rd
ROUTE 128
Craft's Rd
ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

Figure 5-3
Conceptual Improvements
Exit 12: Route 128 at Craft's Road
Gloucester

CTPS

Concord St
ROUTE 128
ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

Figure 5-4
Conceptual Improvements
Exit 13: Route 128 at Concord Street
Gloucester

CTPS

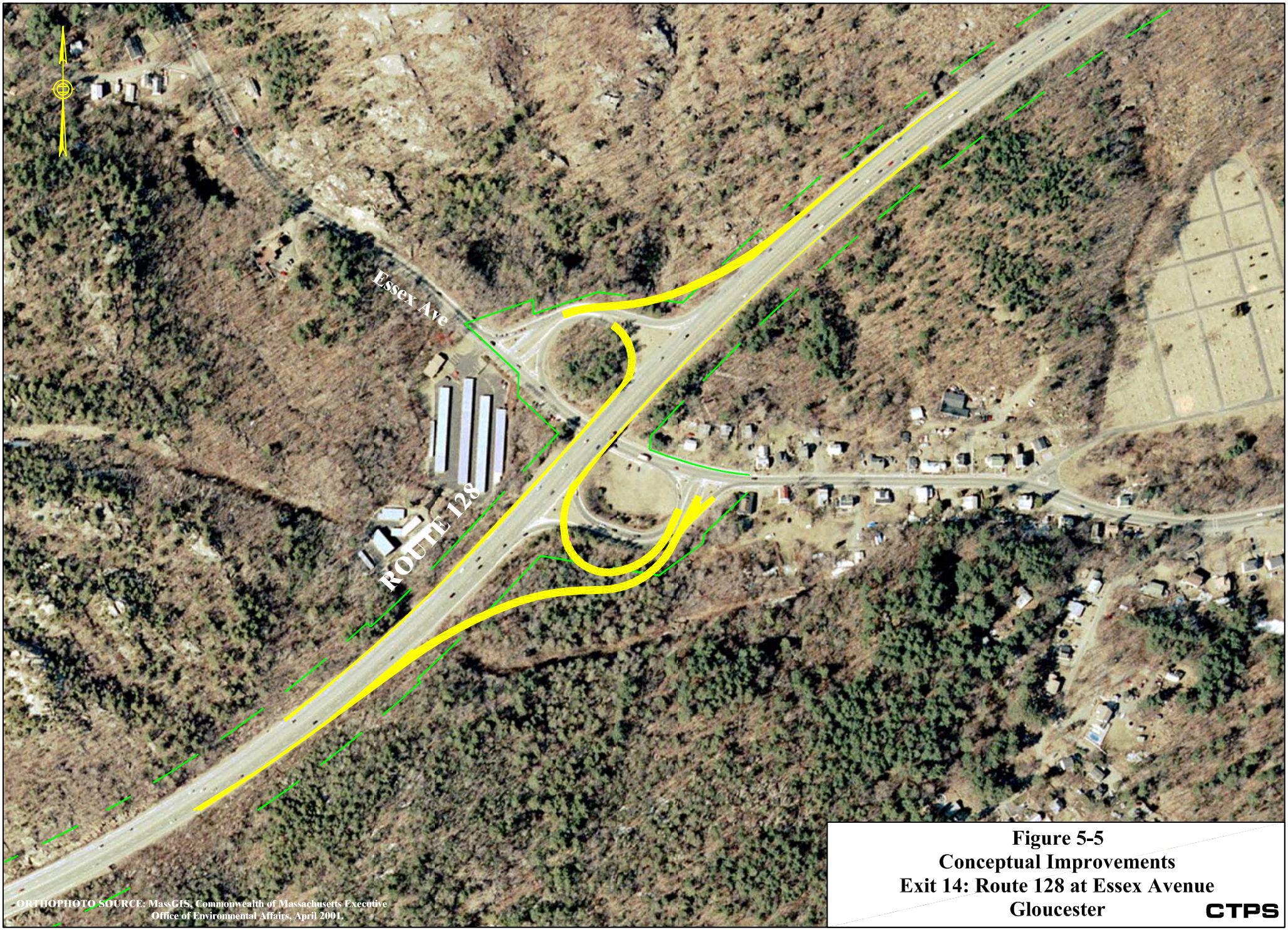


Figure 5-5
Conceptual Improvements
Exit 14: Route 128 at Essex Avenue
Gloucester

CTPS

ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

Figure 5-6
Conceptual Improvements
Exit 15: Route 128 at School Street
Manchester-by-the-Sea

CTPS

ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

Figure 5-7
Conceptual Improvements
Exit 16: Route 128 at Pine Street
Manchester-by-the-Sea

CTPS

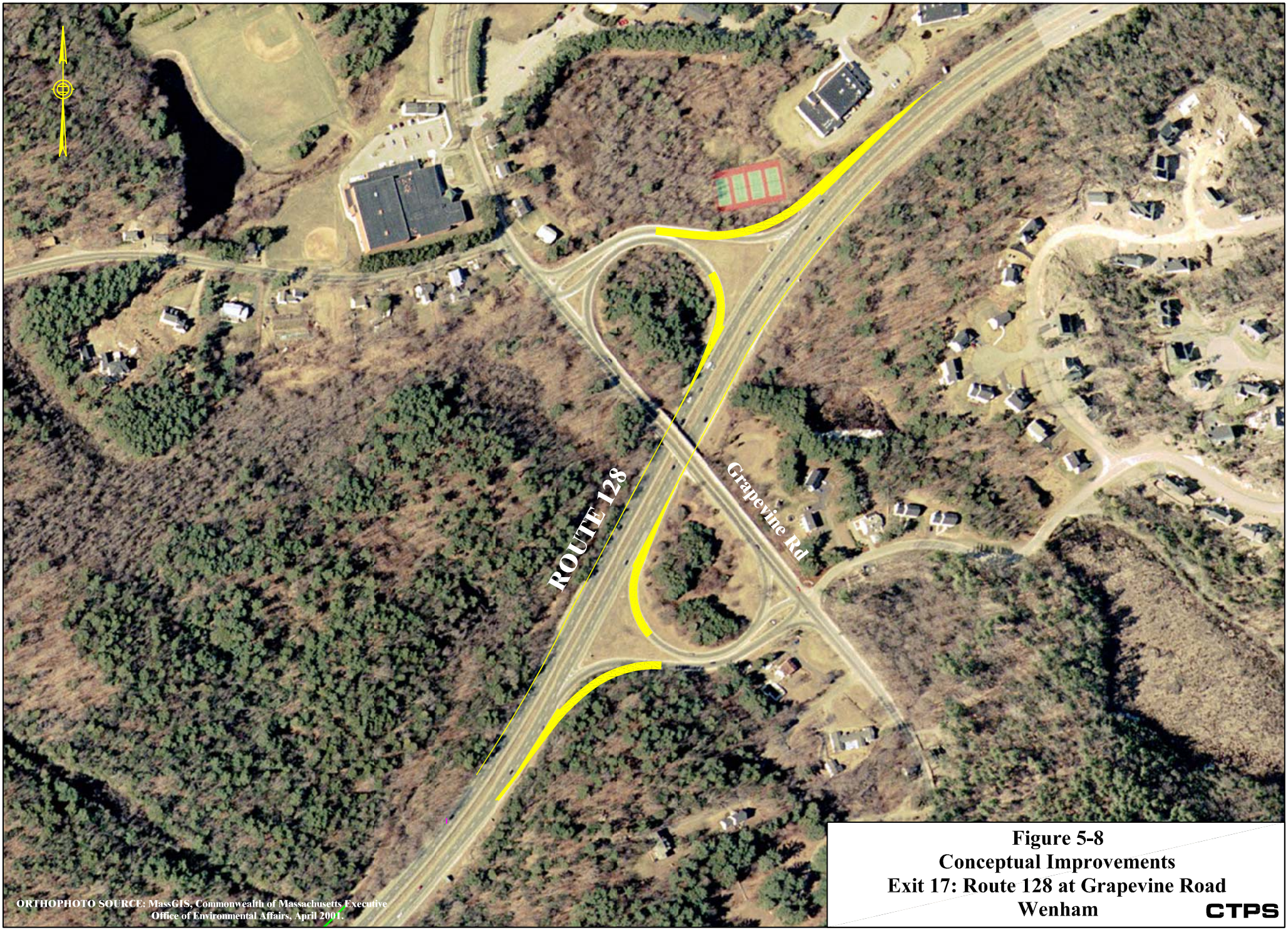

ROUTE 128
Grapevine Rd
ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

Figure 5-8
Conceptual Improvements
Exit 17: Route 128 at Grapevine Road
Wenham

CTPS

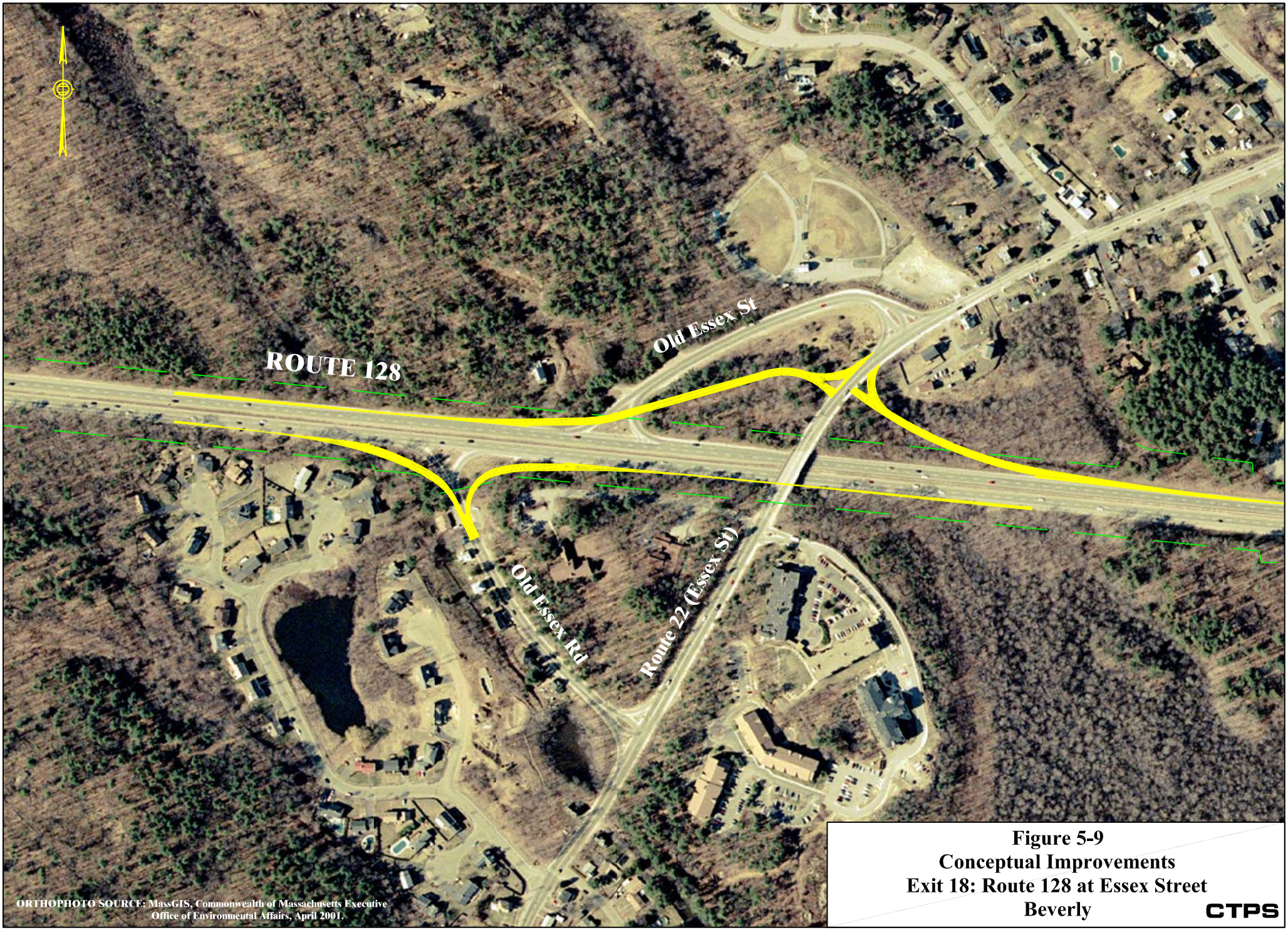

ROUTE 128
Old Essex St
Old Essex Rd
Route 22 (Essex St)
ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

Figure 5-9
Conceptual Improvements
Exit 18: Route 128 at Essex Street
Beverly

CTPS

ORTHOPHOTO SOURCE: MassGIS, Commonwealth of Massachusetts Executive Office of Environmental Affairs, April 2001.

Figure 5-10
Existing Interchange Layout
Exit 19: Route 128 at Brimbal Avenue
Beverly

CTPS

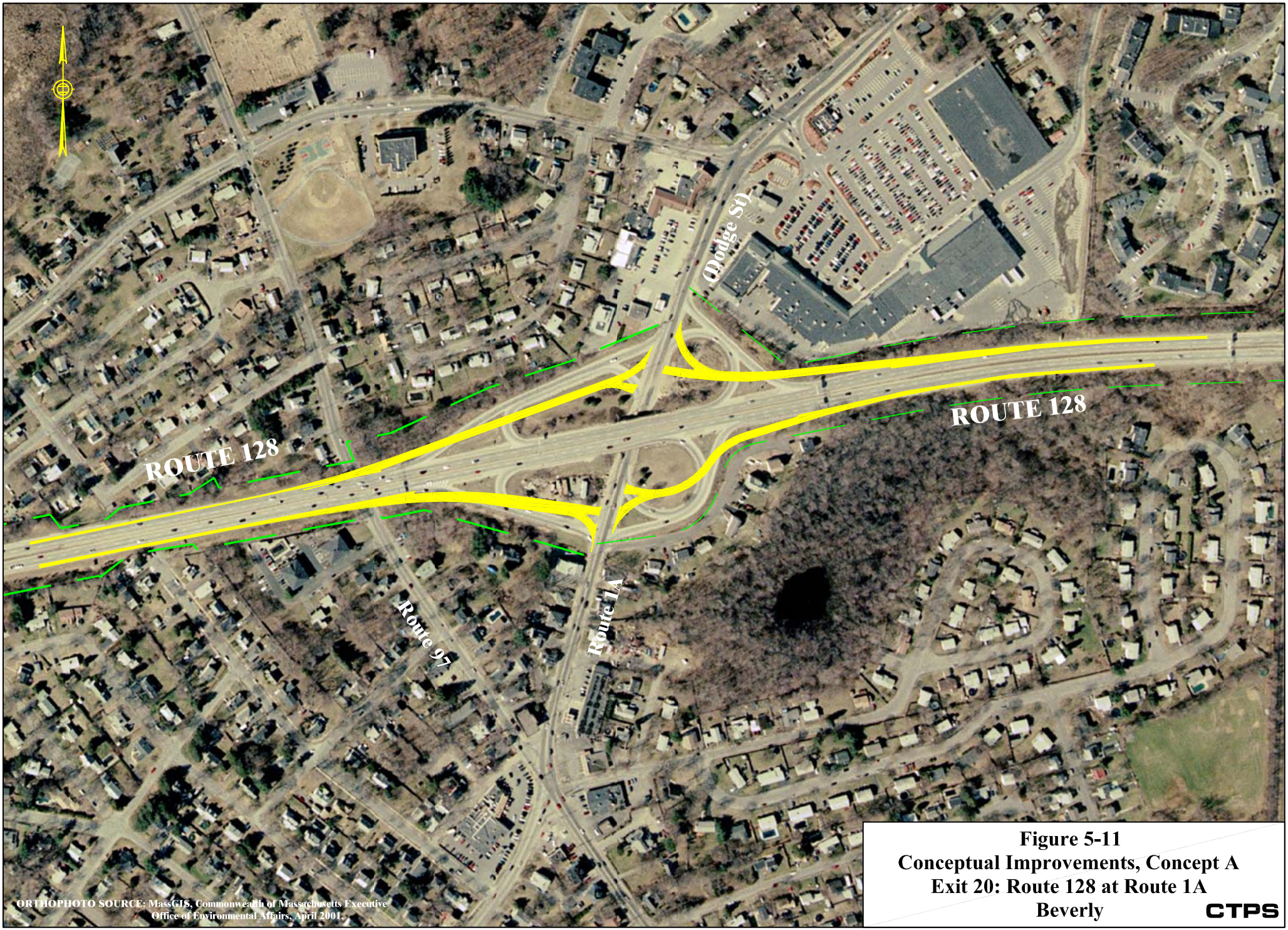


Figure 5-11
Conceptual Improvements, Concept A
Exit 20: Route 128 at Route 1A
Beverly

CTPS

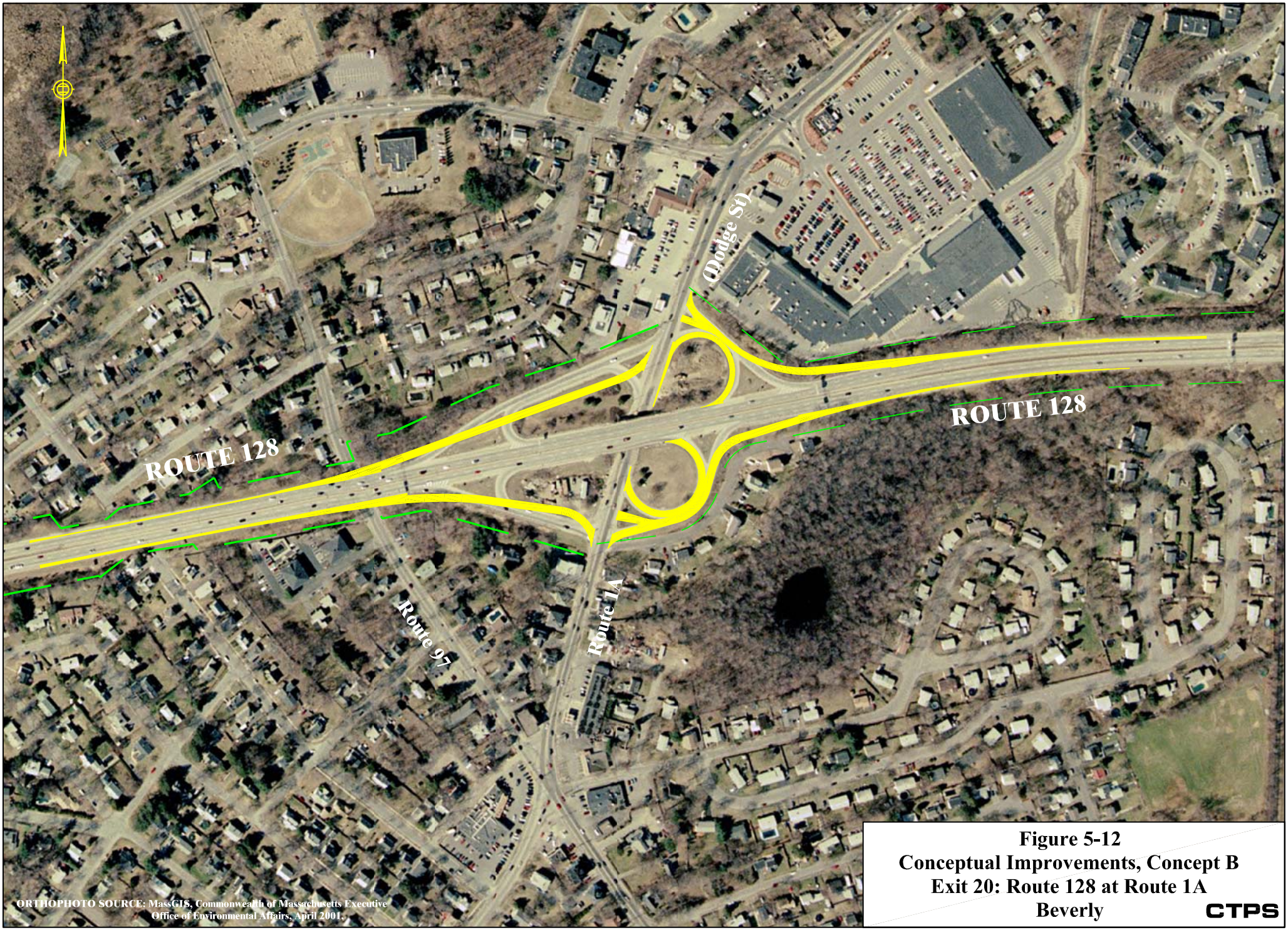


Figure 5-12
Conceptual Improvements, Concept B
Exit 20: Route 128 at Route 1A
Beverly

CTPS

6 RECOMMENDATIONS

This chapter summarizes this study's recommended transportation improvements for the 11 Route 128 interchanges that were examined. The recommendations are based on analyses of the existing traffic conditions and of those projected for the future. They are presented in two categories: short-range and long-range improvements. It should be noted that the improvements recommended in this report are generally conceptual only and would all be subject to community consensus building, further engineering study, and any required environmental reviews prior to implementation.

6.1 Short-Range Improvements

This category consists of interchange improvements that can be completed in a relative short time (within approximately three to five years in most cases) once funding is available. These improvements do not involve major reconstruction of the interchange or major acquisition of right-of-way. A need for a longer design and construction period may be encountered for Exit 13, Exit 14, Exit 15, or Exit17, if further engineering studies reveal that a major modification of its associated crossroad bridge is required to accommodate the expansion of acceleration and deceleration lanes.

- Exit 10: Route 128 at Blackburn Circle, Gloucester
  - Add a lane on Route 128 northbound from the interchange toward Exit 9 (Eastern Street)

- Exit 11: Route 128 at Grant Circle, Gloucester
  - Improve pedestrian and bicycle safety by relocating the crosswalk and upgrading signage

  (Note: Long-range improvements are also recommended for Exit 11; see the following section.)

- Exit 12: Route 128 at Craft's Road, Gloucester
  - Lengthen the acceleration lane from the Ye Olde County Road on-ramp to Route 128 southbound
  - Lengthen the deceleration lane from Route 128 northbound to Craft's Road

- Exit 13: Route 128 at Concord Street, Gloucester
  - Maintain the layout of the two loop ramps and lengthen their acceleration lanes
  - Lengthen the deceleration lanes in both directions

- Exit 14: Route 128 at Essex Avenue, Gloucester
  - Maintain the layout of the north loop ramp and lengthen its acceleration lane
  - Improve the radius and geometry of the south loop ramp and lengthen its acceleration lane
  - Lengthen the deceleration lanes in both directions

- Exit 15: Route 128 at School Street, Manchester-by-the-Sea
  - Maintain the layout of the two loop ramps and lengthen their acceleration lanes
  - Lengthen the deceleration lanes in both directions

- Exit 16: Route 128 at Pine Street, Manchester-by-the-Sea
  - Lengthen the deceleration lane from Route 128 southbound to Pine Street

- Exit 17: Route 128 at Grapevine Road, Wenham
  - Maintain the layout of the two loop ramps and lengthen their acceleration lanes
  - Lengthen the deceleration lanes in both directions
  - Improve pedestrian safety with sidewalk and crosswalk improvements

- Exit 18: Route 128 at Essex Street, Beverly
  - Construct half-diamond-interchange ramps on Route 128 southbound
  - Lengthen the deceleration and acceleration lanes on Route 128 northbound
  - Periodically monitor the traffic at the off-ramp of Route 128 northbound and install a traffic signal or other improvements at the ramp terminus if necessary

6.2 Long-Range Improvements

This category consists of interchange improvements that would take more time to complete (possibly more than five years). These improvements involve major reconstruction of the interchange and require some right-of-way acquisition.

- Exit 11: Route 128 at Grant Circle, Gloucester
  - Further study is required
  - Potential improvements include grade separation of Washington Street, signalization, or other options

- Exit 19: Route 128 at Brimbal Avenue, Beverly
  - The city is currently conducting a study of this interchange; MassHighway will evaluate results and recommendations of the study

- Exit 20: Route 128 at Route 1A, Beverly
  - Further study is required
  - Potential improvements include conversion to a diamond interchange, elimination of the two tight loop ramps, or conversion to a single point urban interchange.

6.3 Consideration of Aesthetics

The North Shore Task Force suggested that the scenic character of the study area corridor be considered in the process of designing interchange improvements. The corridor is noteworthy for its natural beauty and scenic character. Improvements at the interchanges should be designed to enhance visitors' aesthetic experience. It would be beneficial to include tree planting and other landscape elements in the improvement plans.

APPENDIX A

Public Participation

1. July 2002 North Shore Task Force Meeting Agenda
2. January 2003 North Shore Task Force Meeting Agenda
3. Written Comments

You are cordially invited to a meeting of the
NORTH SHORE TASK FORCE
Thursday, July 11, 2002
8:30 – 10:30 AM
Rockport Public Library
School Street
Rockport

AGENDA

Directions for off islanders:

1. Travel on Route 128 North to Gloucester and proceed through two rotary circles to Exit 10.
2. At Exit 10 turn left onto Route 127 North (Eastern Avenue) to Rockport.
3. Travel approximately 3.1 miles along Route 127 to Five Corners, Rockport.
4. At five Corners, bear right onto Route 127A, Broadway.
5. Travel along Route 127A for approximately 0.4 mile to the Rockport Public Library, a two story granite building located on the left at the corner of Broadway and School Streets.
6. Park behind the building in the Library Parking Lot or in Town Hall lot on Broadway if library is full.

1.	**WELCOME** David Folsom, Essex Board of Selectmen and Chair of NSTF	8:30
2.	**COMMUNITY UPDATE** Nick Barletta, Rockport Board of Selectmen	8:35
3.	**UPDATE ON ROUTE 128 EXPANSION STUDY** Efi Pagitsas, Central Transportation Planning, Traffic Analysis and Design Manager	8:50
4.	**INTRODUCTION TO SUSTAINABLE LANDSCAPING PRACTICES** Catherine Campbell, Mass Coastal Zone Management Assistant North Shore Coordinator and Conway School of Landscape Design	9:20
5.	**UPDATE ON MAPC REGIONAL GROWTH INITIATIVE** MAPC Staff	10:00
6.	**ELECTION OF NSTF FY 2003 CHAIR AND VICE CHAIR**	10:15
7.	**ADJOURN**	10:30

Reminder: The NSTF will not meet in August. Next meeting will be September 12.

IF YOU CAN NOT ATTEND:
Please contact Sam Cleaves NSTF Coordinator by Tuesday, July 9, at (617) 451-2770 x2013 or scleaves@mapc.org. **All meetings are open to the public.**

You are cordially invited to a meeting of the
NORTH SHORE TASK FORCE
Thursday, January 16, 2003
North Shore Chamber of Commerce
5 Cherry Hill Drive
Danvers, MA
8:30 – 10:30 AM

Directions: From Route 128 North: Take Exit 22. At end of ramp, take a right, go under Route 128 and take your first right. Continue to fork and bear right. Take a left at Flatley Co./ Cherry Hill Park sign onto Cherry Hill Drive. NS COC is first building on right.
From Route 128 South: Take Exit 21 and turn left onto Conant St. at end of amp. Take first right onto Cherry Hill Drive. NS COC is first building on right.

REVISED AGENDA

1. **WELCOME**
   Christine Rasmussen, Gloucester City Council and Chair of NSTF 8:30

2. **Jim Gallagher and Holly St. Clair of MAPC** will review with SWAP the DRAFT population and employment projections that have been mailed out to the local communities for review (and emailed to SWAP representatives). 8:35

3. **NEW MAPC EXECUTIVE DIRECTOR MARC DRAISEN**
   Marc Draisen introduces himself to the NSTF and take questions. 8:45

4. **FEASIBILITY ANALYSIS OF SAFETY AND OPERATIONAL IMPROVEMENTS AT ELEVEN ROUTE 128 INTERCHANGES, BEVERLY TO GLOUCESTER**
   The MassHighway/Central Transportation Planning Staff study team will present the latest progress on this project, including conceptual design ideas for safety and operational improvements at most interchanges. A study scope summary is attached. 9:15

5. **COMMUNITY UPDATE**
   Karen Nelson, Danvers Planning Director, or alternate
   10:00

6. **CTPS REGIONAL PLAN UPDATE** 10:15
   David Mohler, CTPS

7. **SET NEXT MEETING**
   10:25

8. **ADJOURN**
   10:30

CITY OF GLOUCESTER

GLOUCESTER · MASSACHUSETTS · 01930

Community Development Department
Planning Division
22 Poplar Street
Phone: (978) 281-9781
Facsimilie: (978) 281-9779

February 28, 2003

Mr. Stanley Woods
Highway Design Engineer
Massachusetts Highway Department
10 Park Plaza
Boston, MA 02116

Efi Pagitsas
Manager of Traffic Analysis and Design
Central Transportation Planning Staff
Room 2150
10 Park Plaza
Boston, MA 02116

By Facsimilie to: (617) 973-8855

Re: Feasibility Analysis of Safety and Operational Improvements at Eleven Route 128 Interchanges (Gloucester, et al).

To Whom It May Concern:

I have the following comments in regards to a January 16, 2003 presentation by MassHighway and CTPS on the above referenced study of Route 128 interchanges in Beverly, Wenham, Manchester and Gloucester. I base my comments on the January 16, 2003 presentation and the 32-page meeting handout.

1. Crash data is presented for the set of rotaries under study. I recommend formulation of accident incidence rates. This statistic would be informative regarding the magnitude of problems at different locations.

2. It would be beneficial to have further breakdown of accidents by intersection by either time or day and/or direction of travel.

02/28/2003 17:04 9782819779 PAGE 02

3. It could be beneficial to have a breakdown of accidents by peak summer season versus the rest of the year. Of particular interest is Exits 11 and 14.

4. Regarding Exit 11:
   a. There is indication that capacity concerns exist at Exit 11 'Grant Circle' rotary. It would be beneficial to have the all of actual count data for the peak hour level of service included in the study.
   b. It is requested that the document contain descriptions on the extent of and characteristics of capacity concerns.
   c. Are there differences in these patterns during peak- versus off-season?
   d. Is it feasible to analyze how the intersection of Poplar Street and Washington Street functions and whether it impacts the 128 intersection? The rationale is that it could be beneficial to obtain analysis regarding whether there are ways to optimize the function of this intersection as a low cost way to ensure that the rotary works well.
   e. While I understand that it is MassHighway's recommendation that further analysis of grade separation at this intersection is warranted, it would be beneficial to have written descriptions of findings and recommendations up to this point. That information could be useful in guiding and developing future studies.
   f. Is it possible to employ more frequent painting and re-striping at this location during the interim study period as a way to enhance performance and safety of this intersection?
   g. Future analysis for potential design modifications at this intersection should explore ways to provide for enhanced bicycle circulation.

5. Regarding Exit 13:
   a. Assuming the graphics presented are to scale in the conceptual improvements diagram, it seems warranted to have a wider acceleration lane designed on the east- and west-bound lanes. Does the existing bridge pose a constraint to laying out a wider acceleration lane east- or west-bound? If so, when would this bridge be due for repair, and is it feasible to coordinate some limited bridge widening at that point in order to achieve a wider acceleration lane?

6. Regarding Exit 14:
   a. It is surprising that there are not a higher number of accidents on the west-bound (northern) side of Route 128.
   b. Assuming the graphics presented are to scale in the conceptual improvements diagram, it seems warranted to have a wider acceleration lane designed on the east-bound lane.
   c. Does the existing bridge pose a constraint to laying out a wider acceleration lane east- or west-bound? If so, when would this bridge be due for repair, and is it feasible to coordinate some limited bridge widening at that point in order to achieve a wider acceleration lane?

7. It was indicated that it is proposed to provide an extra travel lane between the rotary at Exit 10 and Eastern Avenue utilizing the existing breakdown lane. This is commendable. It is also recommended to explore whether it is desirable and feasible to provide design and engineering for a new point of egress from the east bound travel lane into the undeveloped area that is southeast of Fuller School. The rationale for recommending study of this potential to provide a new off-ramp somewhere after the Fuller School is that some officials have cited concern for limitations in the

02/28/2003 17:04 9782819779 PAGE 03

layout of the Route 128 egress and access linking to the Fuller School. Is it possible that another off-ramp could help alleviate some of problems by the school?

8. At the meeting January 16 one person commented that there is a scenic highway designation assigned to eastern portions of Route 128. Cultural tourism is an important part of this community's and the region's economy. Most of Route 128 within the study area is remarkable for its natural beauty and scenic character. Enhancements at the intersections should be designed to contribute to, and not detract from, the natural and scenic character of the highway. This would enhance the scenic designation and the visitor experience. It would be beneficial to include an ambitious landscape design component to the program developed to upgrade the intersections. It should include tree planting and other physical improvements in order to enhance the transportation experience. An added benefit of ambitious tree planting or other landscaping measures at a location such as exit 14 would be that these measures could help attenuate noise from traffic for nearby residences. The Essex National Heritage Area may be able to provide further comment on this topic.

9. There are salt water wetlands relatively close to intersections 14, 13, 12, and 11. When the intersection upgrades are designed, it would be advantageous to specify innovative stormwater treatment technology within the engineering designs. Such technology could provide environmental mitigation to ensure that there is minimized potential to contaminate resources from highway runoff.

Please take these comments into consideration during development of the study. I look forward to any questions that you may have. I may be reached at (978) 281-9781.

Sincerely,

David P. Gilmour, AICP
Planning Director
City of Gloucester

Copy: Dale Brown, Community Development Director.

02/28/2003 17:04 9782819779 PAGE 04

April 14, 2003

David P. Gilmour
Planning Director
Community Development Department
City of Gloucester
22 Poplar Street
Gloucester, MA 01930

Dear Mr. Gilmour:

Thank you for your comments on the study: Feasibility Analysis of Safety and Operational Improvements at Eleven Route 128 Interchanges in Beverly, Wenham, Manchester-by-the Sea, and Gloucester. They are timely and helpful. Our responses follow in the order of the comments in your letter:

1. Currently there is no standard crash rate formula for rotaries. Rotaries vary in size and usually cover larger area with more traffic conflicting points than regular signalized or unsignalized intersections. The standard intersection crash rate formula (the million-vehicle method) for signalized/unsignalized intersections is not applicable.

2. For the five selected interchanges, crash data was broken down by time of day (peak periods vs. other). Direction of travel can be detected from the collision diagram. Crashes by these various categories will be shown for the selected interchanges in the report.

3. The crash data analysis at Exit 14 indicates that over 40% of the crashes occurred under wet/icy conditions. This implies that crashes at this location were potentially associated more with weather and geometric conditions than with increased summer travels. From the 1996-2000 Registry of Motor Vehicles crash data, about 26% of the crashes occurred in the summer (June 15 to September 15) at Exit 14. This indicates that there is no difference between summer and the other seasons. At Exit 11, about 36% of crashes occurred in the summer (see attached table). This is somewhat higher than the average of the other seasons. It should be noted that traffic volume is generally higher in the summer than other seasons and visitors' unfamiliarity with rotary operation might have contributed to the high number of crashes at this location.

4. The peak hour balanced volumes, levels of service, capacity concerns, and other findings at Exit 11 will all be included in the report. Peak season operations, Poplar Street and Washington Street operations, and pedestrian/bicycle circulation should all be considered in a future study at Exit 11, one of this study's recommendations.

5. The lengthening and widening of the acceleration and deceleration lanes at Exit 13 may require reconstruction of the existing bridge. At this conceptual development stage, we do not have a definite answer. It will be further investigated in the design phase.

6. The westbound (southbound) side of Route 128 approaching Exit 14 is downhill with limited sight-distance toward the exit ramp. The accident reports collected did show a high number of crashes, though somewhat lower than the eastbound side that is downhill from a horizontal

curve. Again, at this location, more accurate field survey and design is required to determine if reconstruction of the existing bridge is needed or not.

7. We believe that the additional lane beyond Blackburn Circle would be beneficial to traffic operations. As to an additional egress/access point in the section, our preliminary assessment is not favorable. It is a design standard to have a distance of one mile or more between two highway interchanges in urban areas, more in rural areas. An egress/access point for Fuller School in this section of Route 128, though not as interfering as an interchange, would still create disturbance with mainline traffic on the highway. It may be marginally beneficial to the school traffic, but it may create additional safety and operational concerns on the highway. The school traffic congestion at the rotary is temporal and is related to the school's circulation system. The driveway (i.e. School Street) from the school parking lot to the rotary is short and traffic is congested during the morning school opening and afternoon school ending periods. Extending the distance to the rotary would provide more storage space for the school traffic. This should be studied by the city with a comprehensive review of the school's parking and circulation system.

8. We have included these suggestions in the report.

9. These are good suggestions and will be incorporated in future design considerations.

Again, thank you for your comments. We recently completed the draft documentation of the study. Once the report is approved by the Transportation Planning and Programming Committee of Boston MPO, we will send a copy to all the members of NSTF (sometime in May). In the mean time, if you have further questions regarding this study, please contact me (617-973-8009) or Efi Pagitsas (617-973-7106). Thank you.

Sincerely,

Chen-Yuan Wang

Chen-Yuan Wang
Project Manager

Encl.

cc: Stanley Wood, MassHighway Design
Hasmukh Patel, MassHighway Design
Efi Pagitsas, CTPS Traffic Engineer and Design

Summer Crashes at Exits 11 and 14
in Gloucester
1996-2000

Location	Year	Total Annual Crashes	Crashes 6/15 to 9/15	Percent of Summer Crashes
Exit 11	2000	33	7	21.21%
	1999	26	10	38.46%
	1998	32	13	40.63%
	1997	29	12	41.38%
	1996	29	11	37.93%
	Total	149	53	35.57%
Exit 14	2000	9	2	22.22%
	1999	19	7	36.84%
	1998	13	4	30.77%
	1997	14	2	14.29%
	1996	10	2	20.00%
	Total	65	17	26.15%

* Source: Registry of Motor Vehicle Crash Database.

Chen-Yuan Wang

From: "Christine Rasmussen" <chrisras@gis.net>
To: <cyw@ctps.org>
Sent: Thursday, March 06, 2003 11:41 AM
Subject: Route 128 improvements

Mr. Wang
Thank you for attending our North Shore Task Force Meeting and providing information on the proposal to improve Route 128 Interchanges.
As the Ward Councilor of the area that includes Exit 13 and 14, I would urge you to prioritize improvements to those sections of the highway, which are dangerous.
With the installation of sewers in West Gloucester, the area is ready for development. According to the Daylor study an additional 858 units of housing will be built in the area at buildout.
There is also a proposal for 130 units of housing being built on Route 133 at the LePage's factory and a couple of smaller projects that involve approximately 50 units.
Christine Rasmussen
Ward 5 Councilor

APPENDIX B

Base Year (2001) Peak Period Balanced Traffic Volumes

Figure B-1

2001 Peak Period Traffic Volumes
Exit 10
Route 128 @ Blackburn Circle, Gloucester

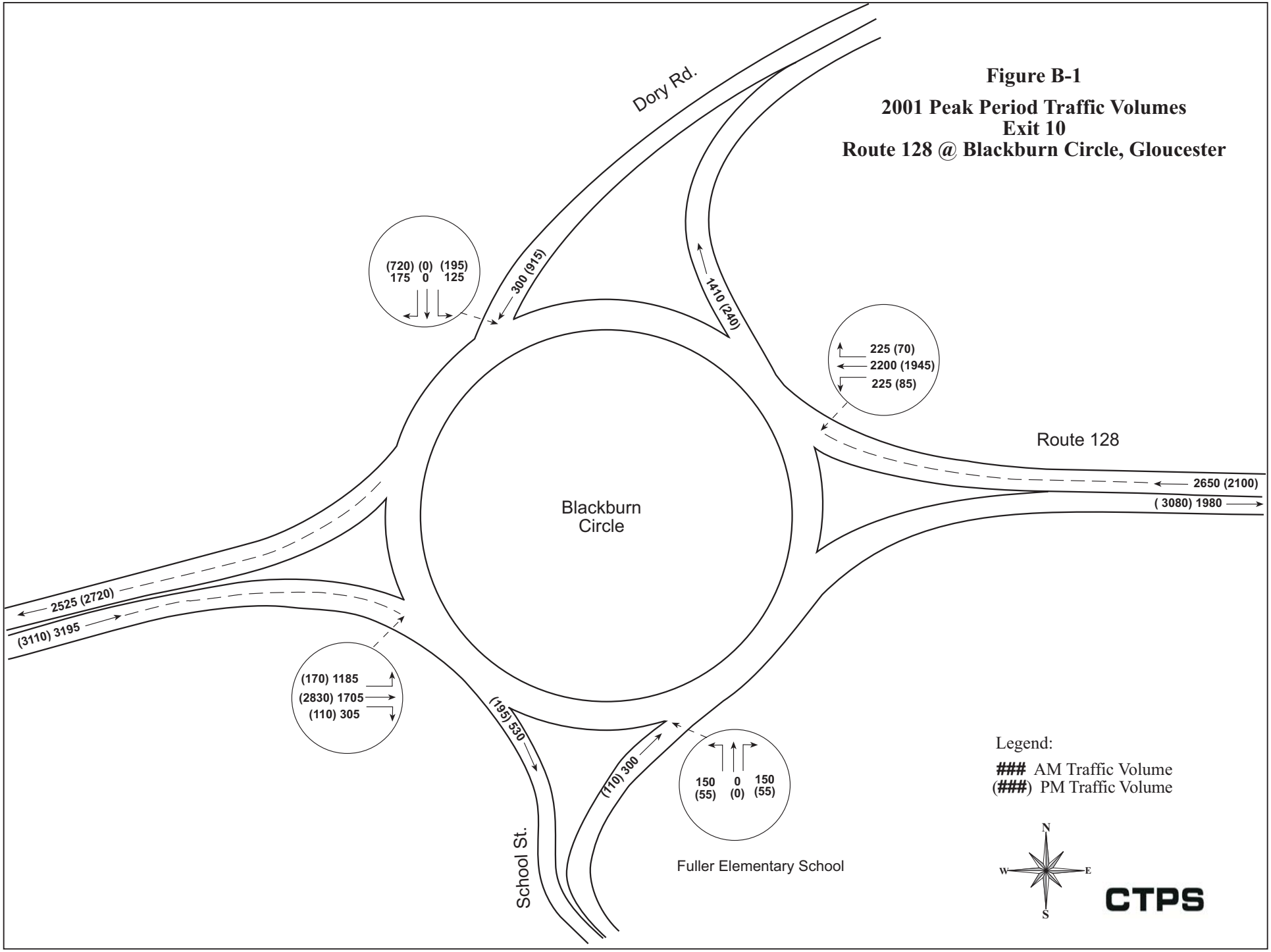


Figure B-2

2001 Peak Period Traffic Volumes
Exit 11
Route 128 @ Grant Circle, Gloucester

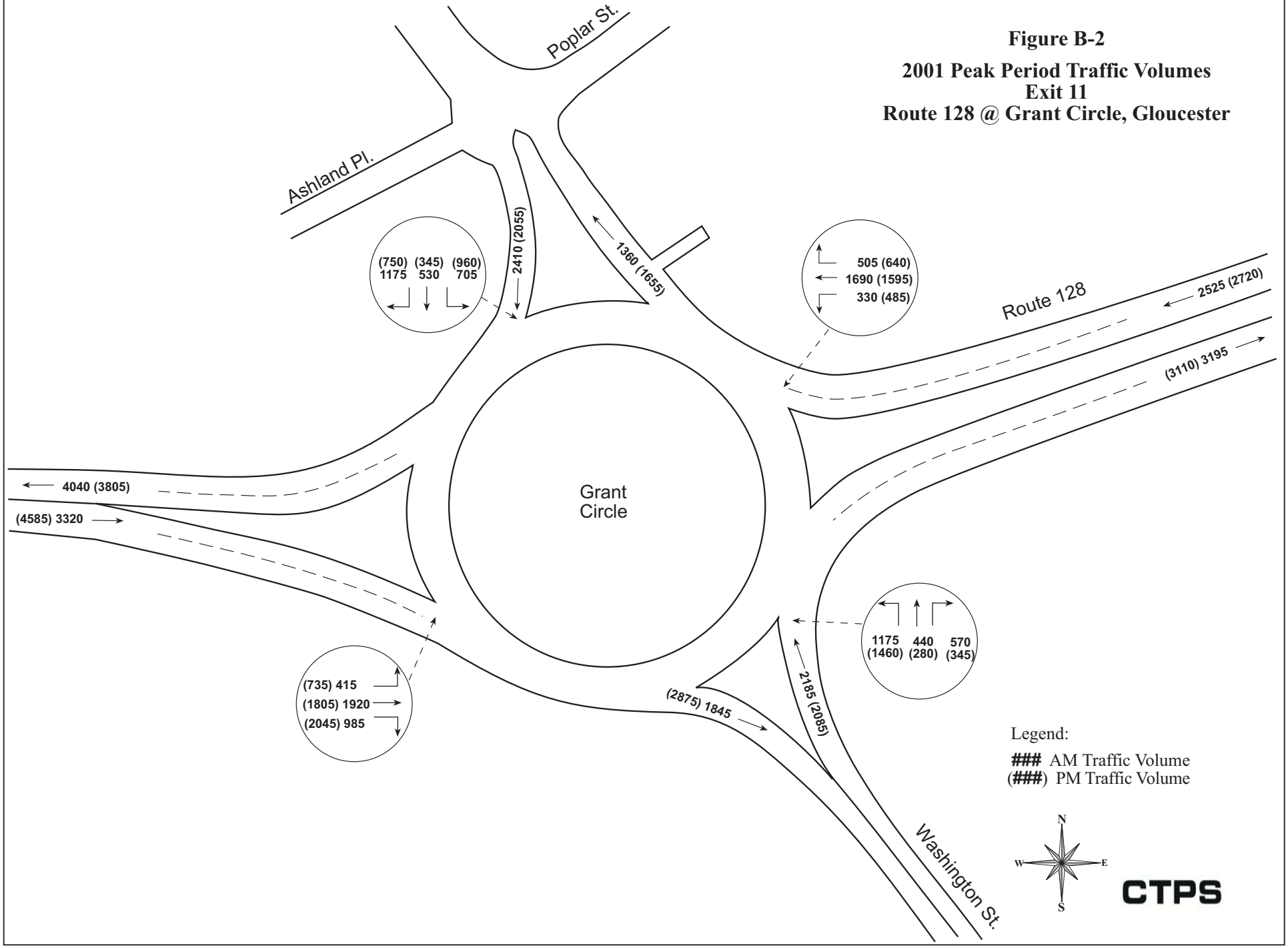


Figure B-3

2001 Peak Period Traffic Volumes
Exit 12
Route 128 @ Craft's Road, Gloucester

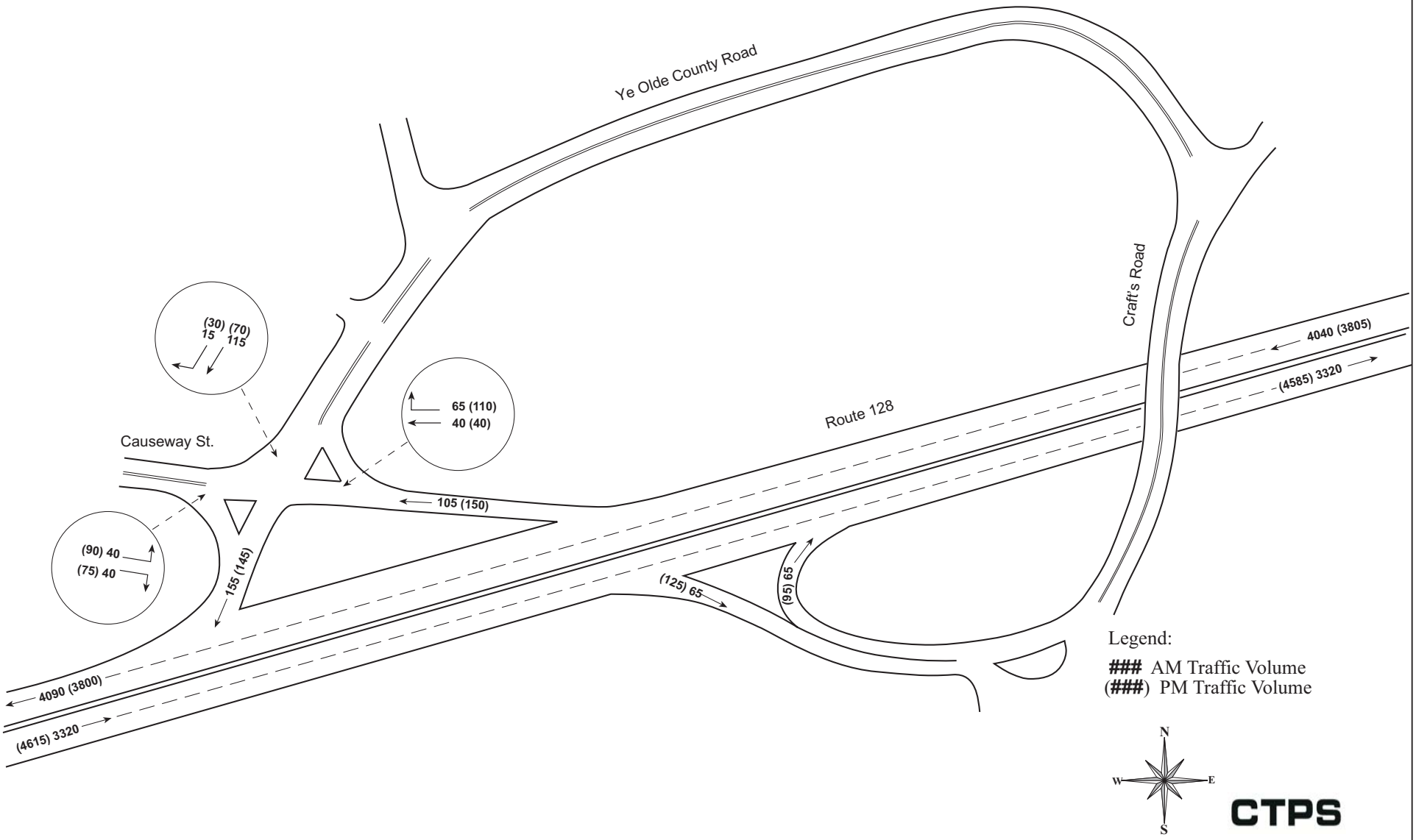
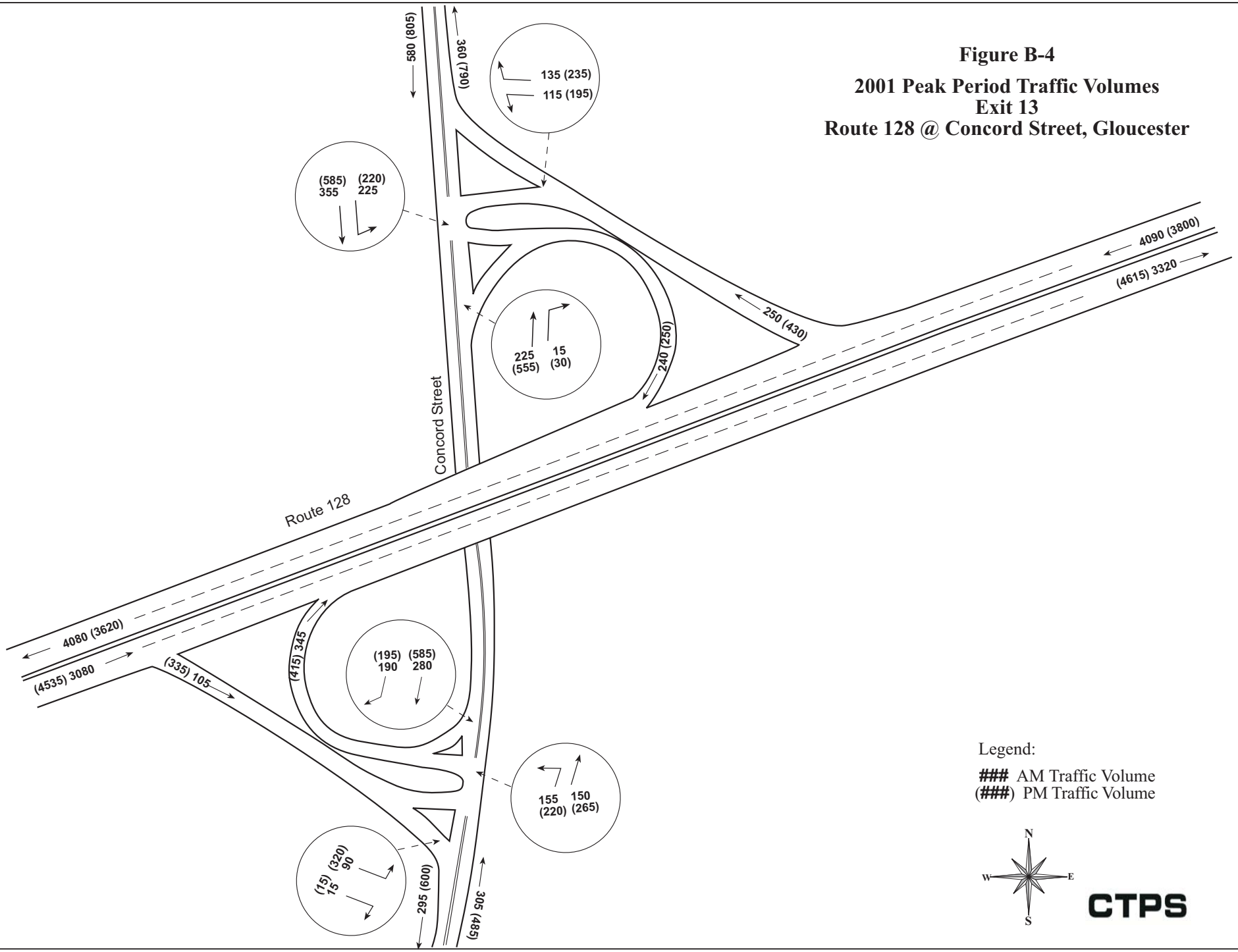


Figure B-4

2001 Peak Period Traffic Volumes
Exit 13
Route 128 @ Concord Street, Gloucester



Legend:

AM Traffic Volume
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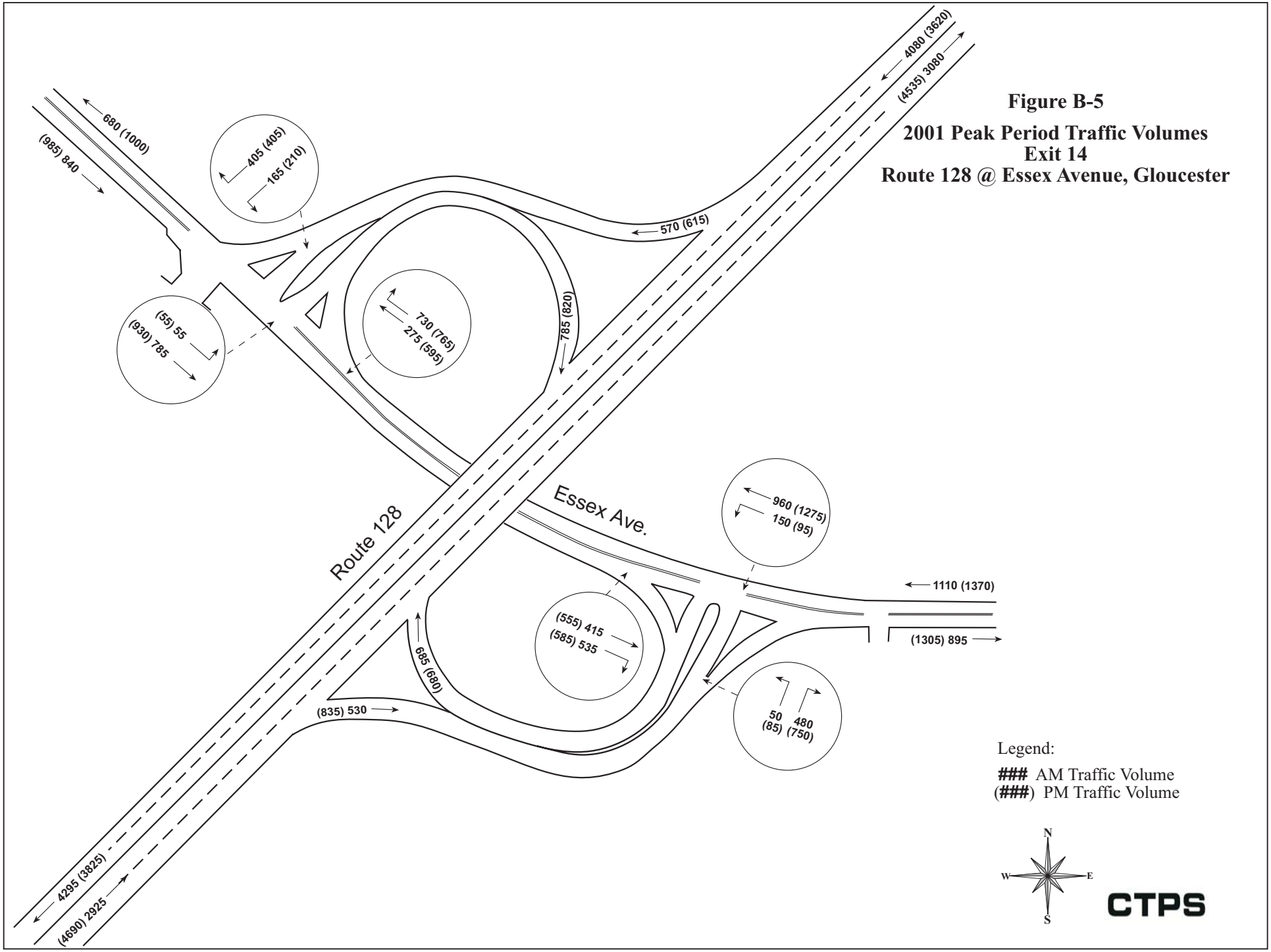
Figure B-5
2001 Peak Period Traffic Volumes
Exit 14
Route 128 @ Essex Avenue, Gloucester
680 (1000)
(985) 840
405 (405)
165 (210)
4080 (3620)
(4535) 3080
570 (615)
730 (765)
275 (595)
785 (820)
(55) 55
(930) 785
Route 128
Essex Ave.
960 (1275)
150 (95)
1110 (1370)
(1305) 895
(555) 415
(585) 535
685 (680)
(835) 530
50
(85)
480
(750)
4295 (3825)
(4690) 2925
Legend:
AM Traffic Volume
(###) PM Traffic Volume
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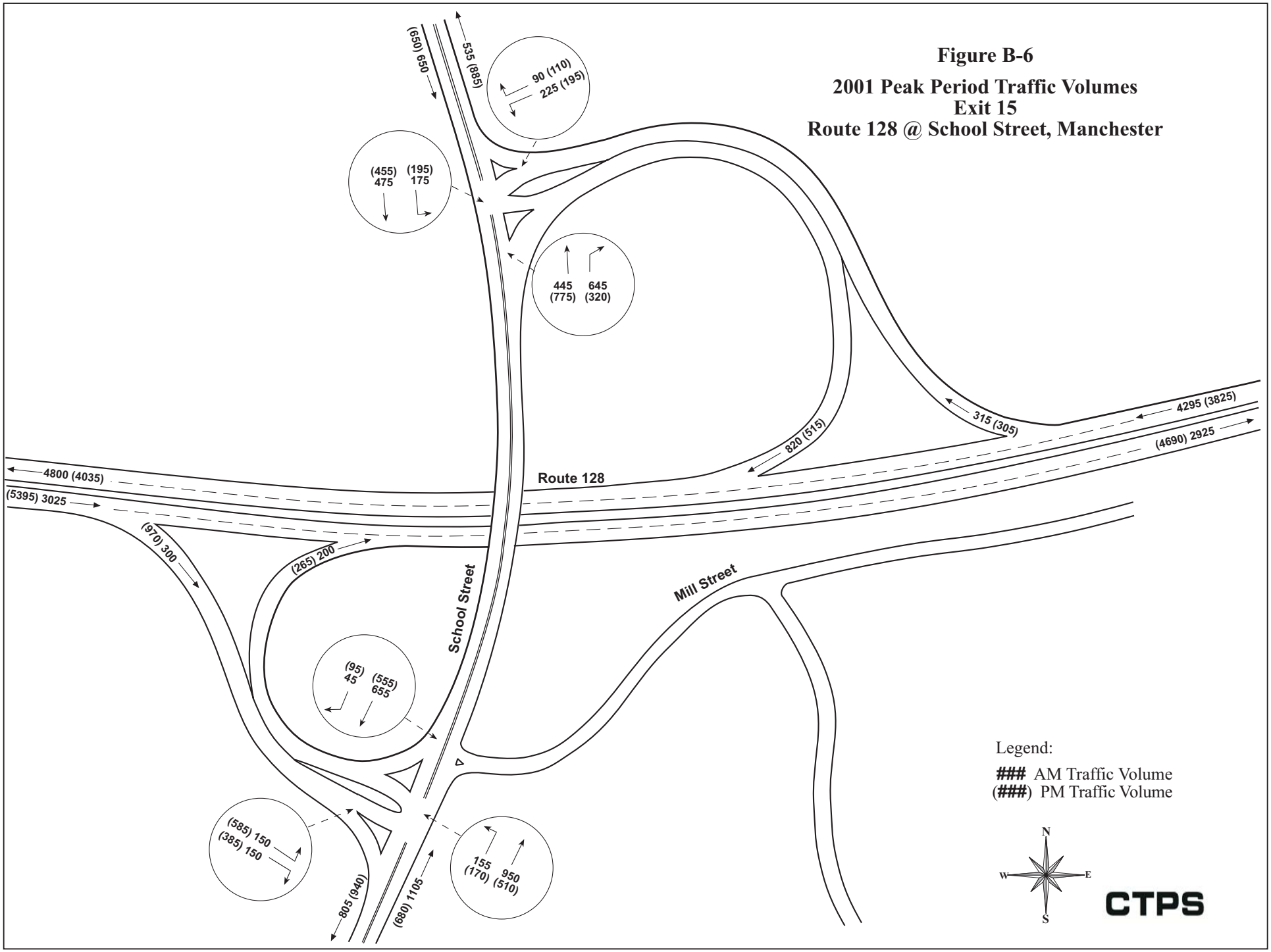
Figure B-6
2001 Peak Period Traffic Volumes
Exit 15
Route 128 @ School Street, Manchester
(650) 650
535 (885)
90 (110)
225 (195)
(455) 475
(195) 175
445 (775)
645 (320)
315 (305)
4295 (3825)
(4690) 2925
820 (515)
4800 (4035)
(5395) 3025
Route 128
(970) 300
(265) 200
School Street
Mill Street
(95) 45
(555) 655
(585) 150
(385) 150
805 (940)
(680) 1105
155 (170)
950 (510)
Legend:
AM Traffic Volume
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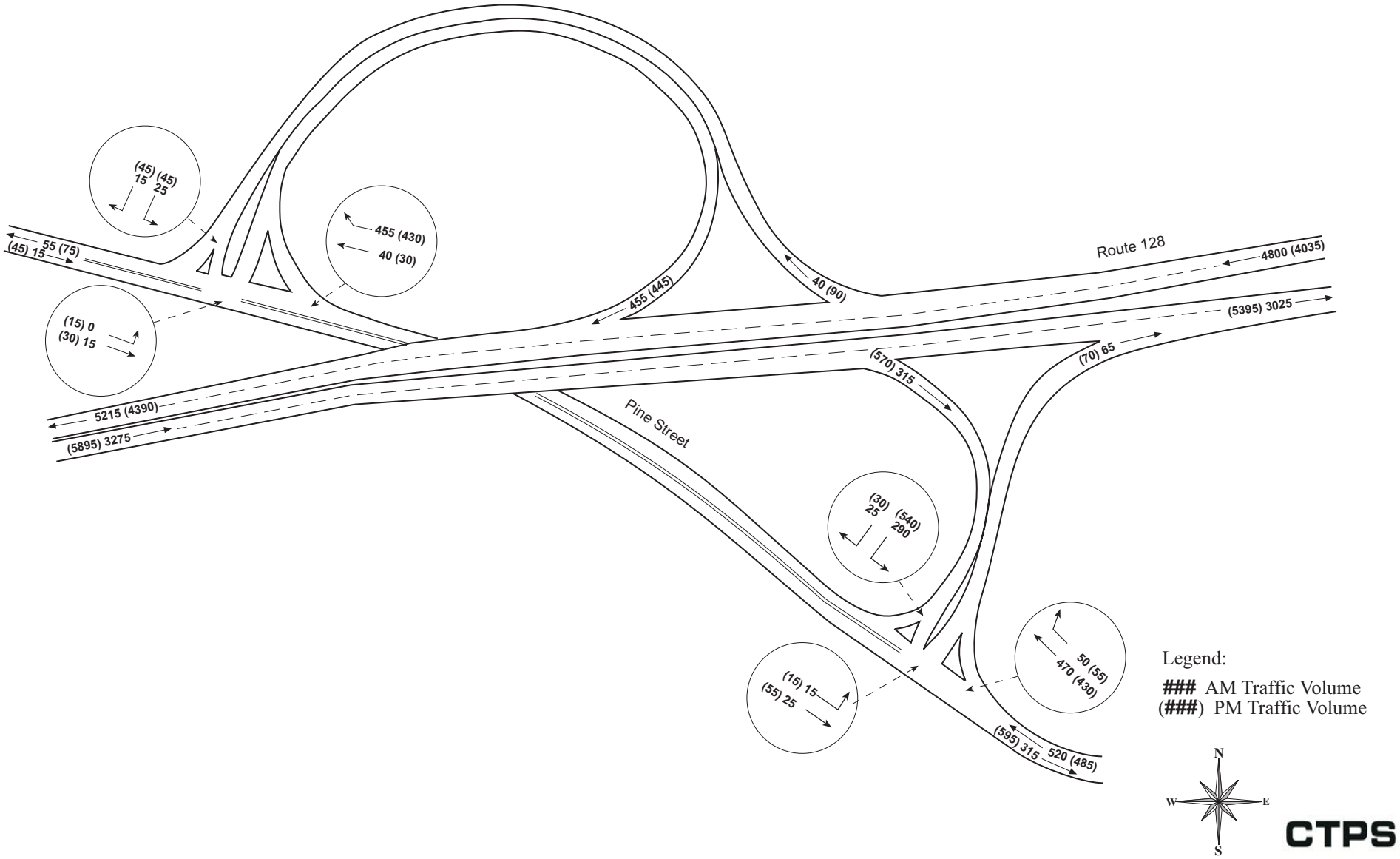
Figure B-7

2001 Peak Period Traffic Volumes
Exit 16
Route 128 @ Pine Street, Manchester



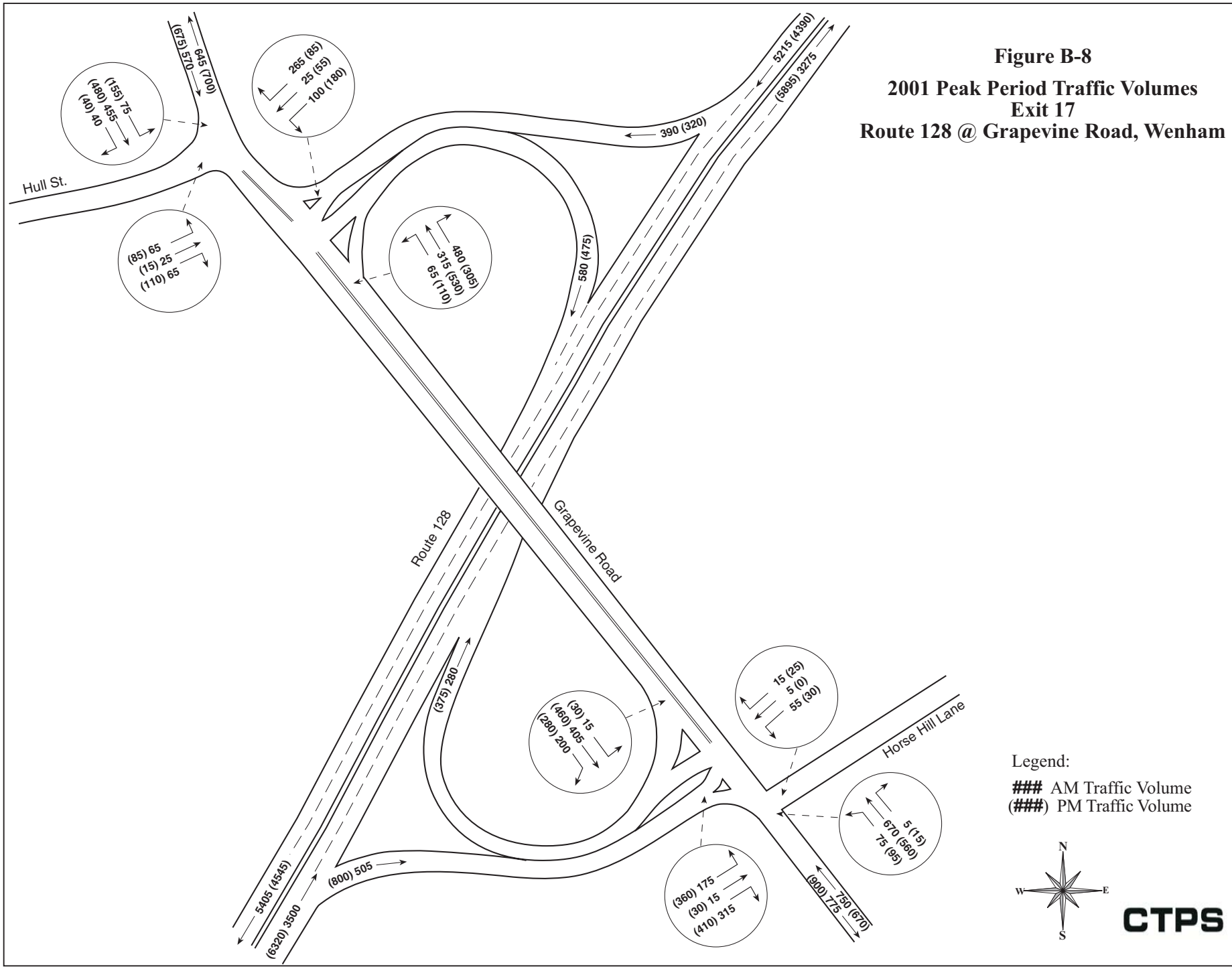


Figure B-8

2001 Peak Period Traffic Volumes
Exit 17
Route 128 @ Grapevine Road, Wenham

Figure B-9

2001 Peak Period Traffic Volumes
Exit 18
Route 128 @ Essex Street, Beverly

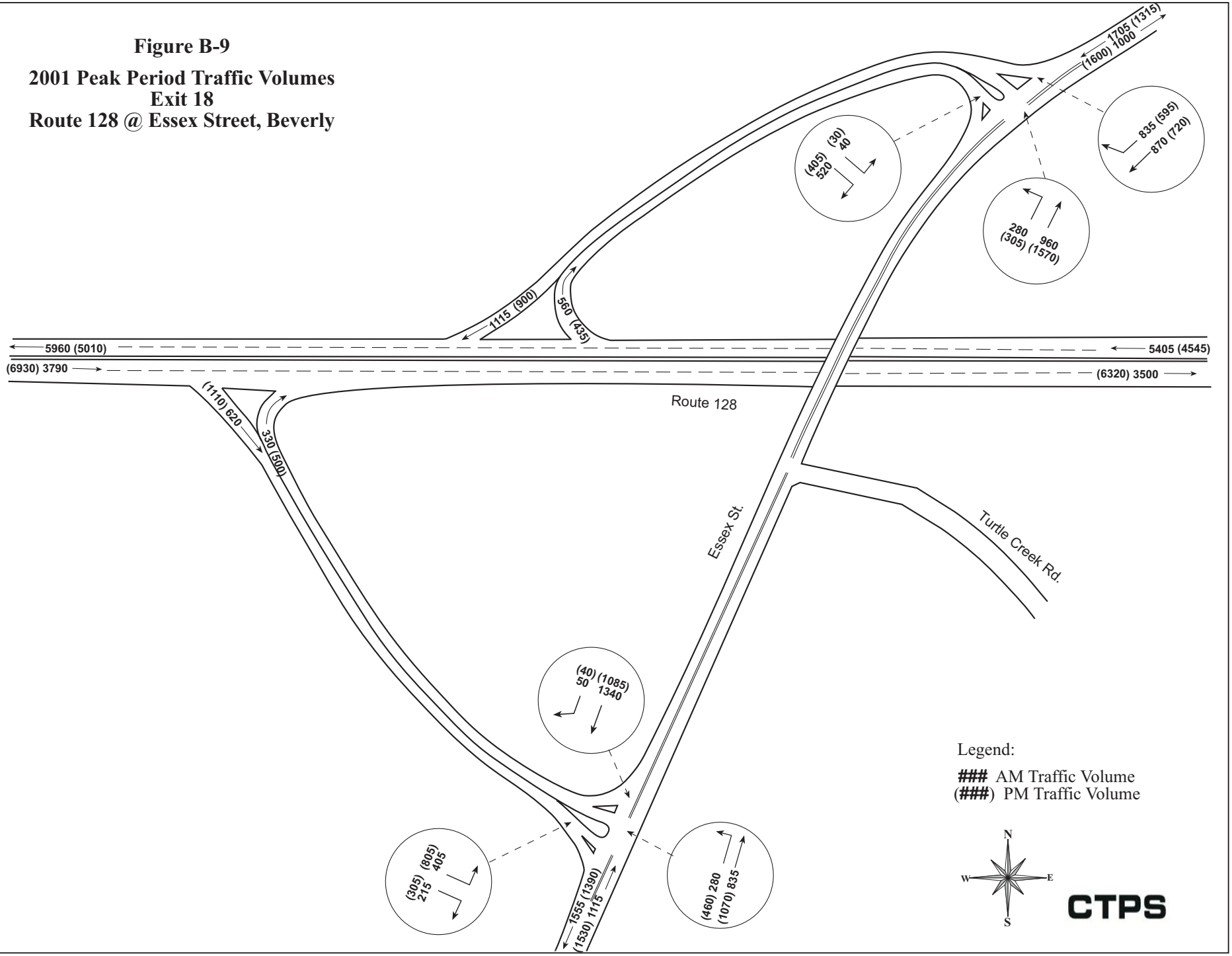


Figure B-10

Exit 19
2001 Peak Period Traffic Volumes
Route 128 @ Brimbal Avenue, Beverly

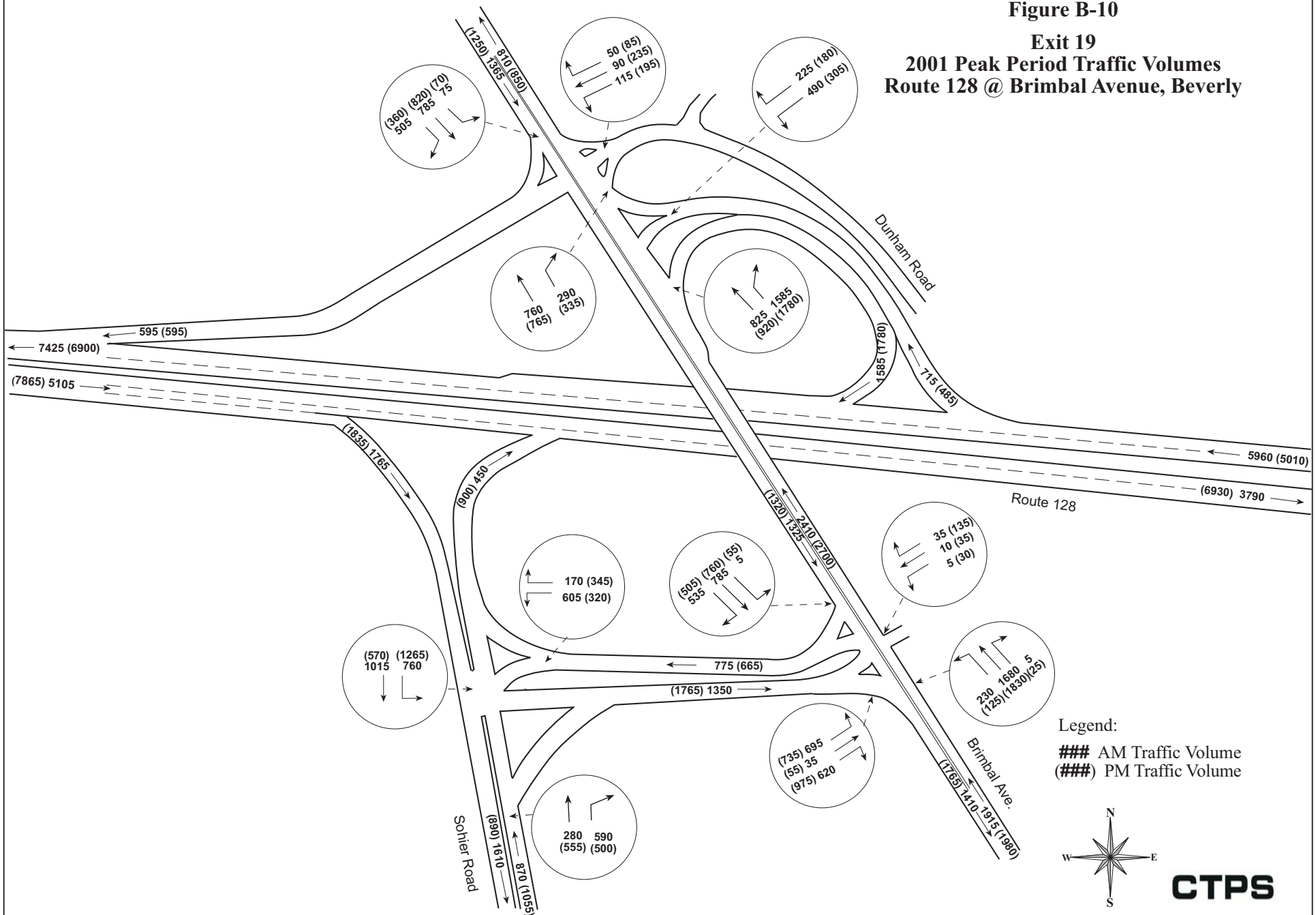
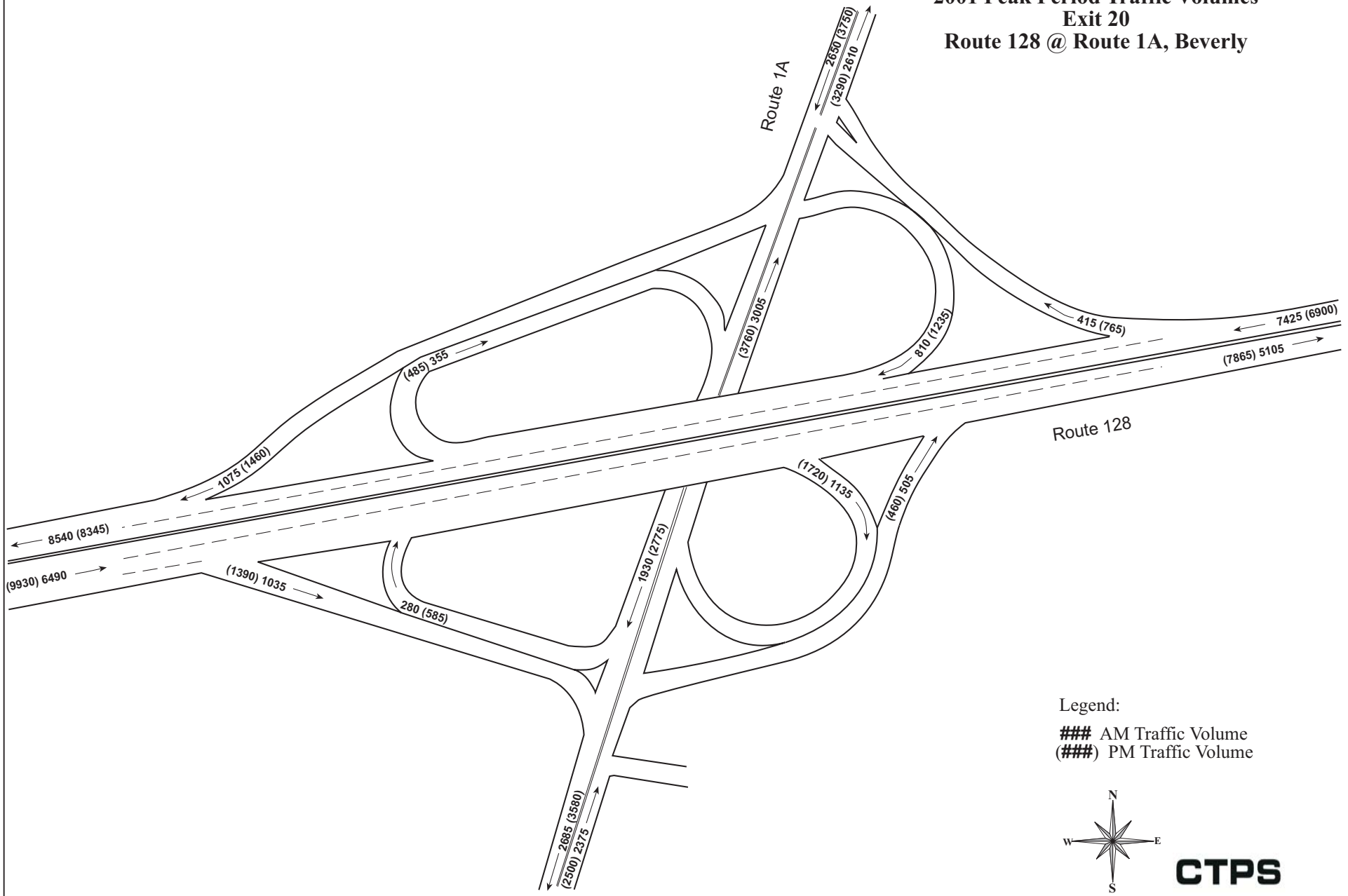


Figure B-11

2001 Peak Period Traffic Volumes
Exit 20
Route 128 @ Route 1A, Beverly



Legend:

AM Traffic Volume
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APPENDIX C

Base Year (2001) Peak Hour Balanced Traffic Volumes

Figure C-1

2001 Peak Hour Traffic Volumes
Exit 10
Route 128 @ Blackburn Circle, Gloucester

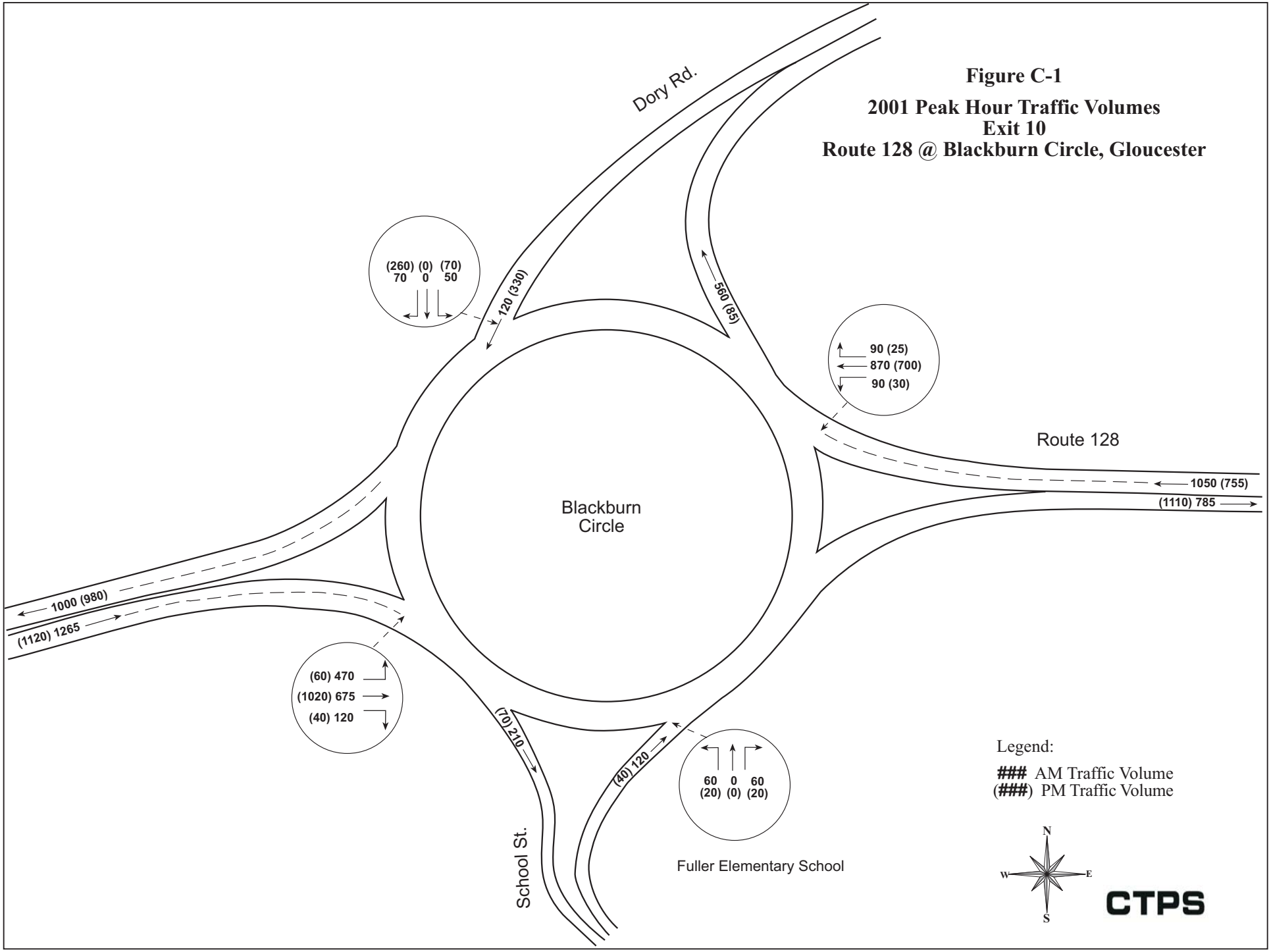


Figure C-2

2001 Peak Hour Traffic Volumes
Exit 11
Route 128 @ Grant Circle, Gloucester

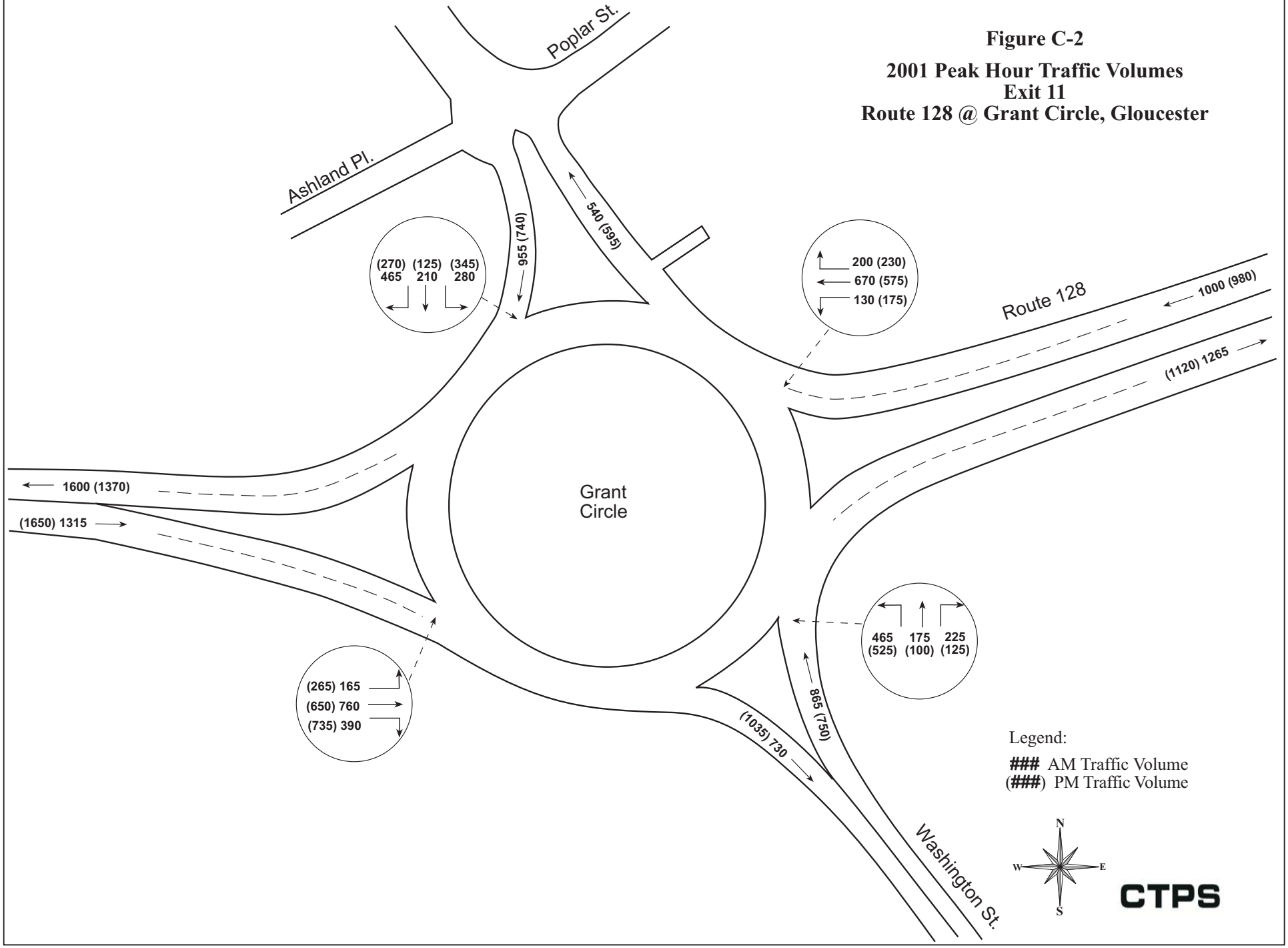
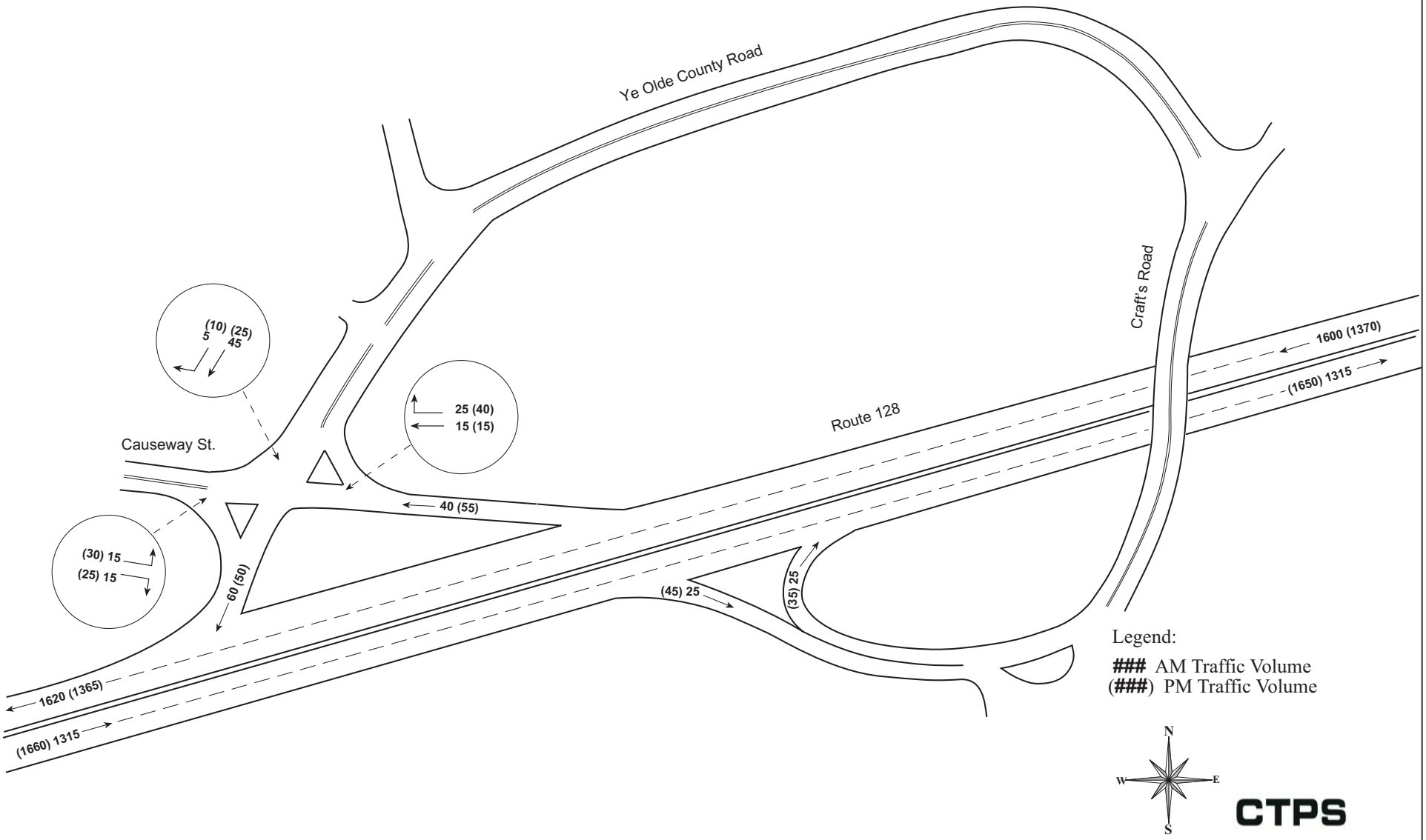


Figure C-3

2001 Peak Hour Traffic Volumes
Exit 12
Route 128 @ Craft's Road, Gloucester



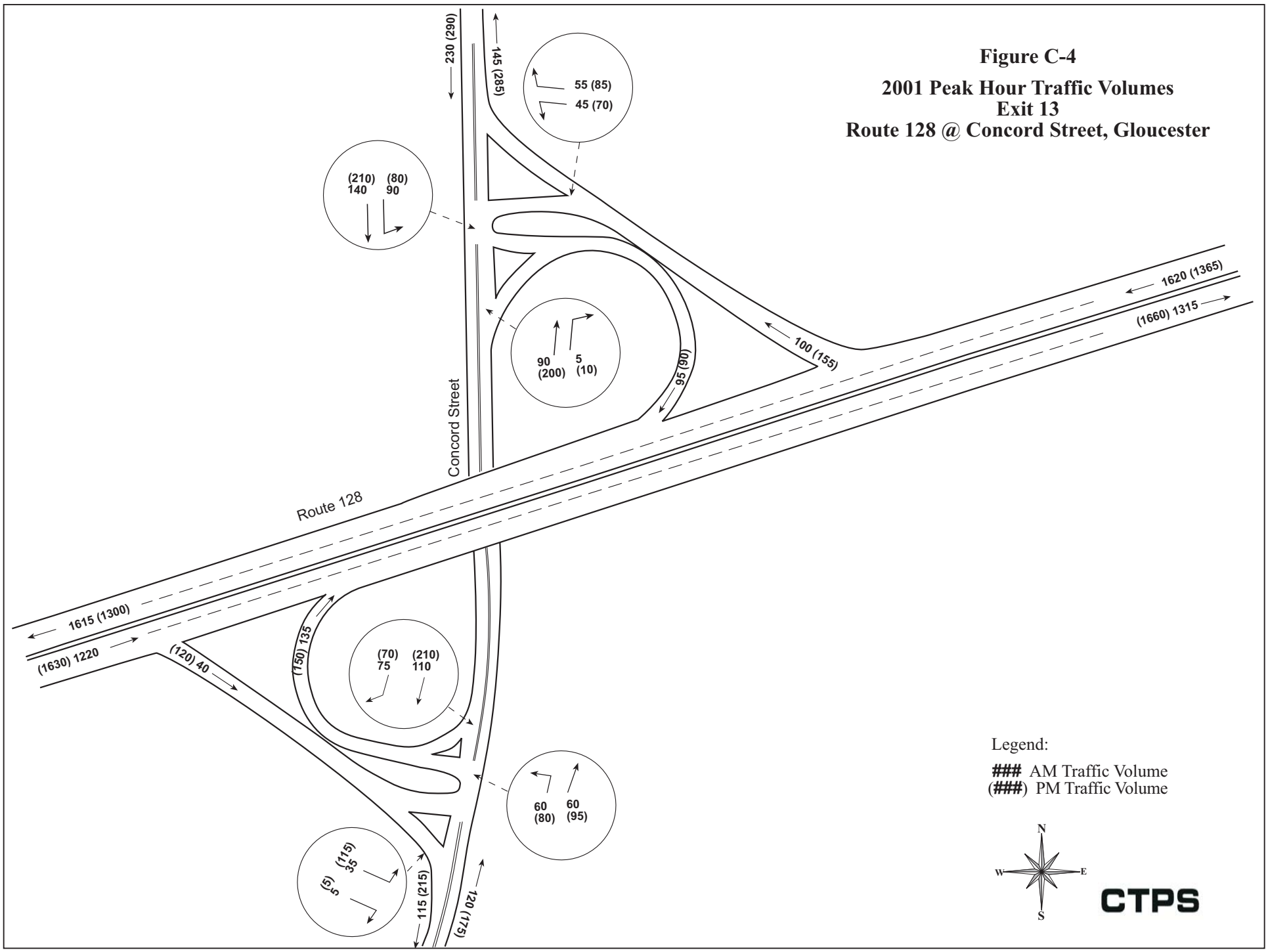


Figure C-4
2001 Peak Hour Traffic Volumes
Exit 13
Route 128 @ Concord Street, Gloucester
230 (290)
145 (285)
55 (85)
45 (70)
(210) 140
(80) 90
1620 (1365)
(1660) 1315
100 (155)
90 (200)
5 (10)
95 (90)
Concord Street
Route 128
1615 (1300)
(1630) 1220
(120) 40
(150) 135
(70) 75
(210) 110
60 (80)
60 (95)
(5) 5
(115) 35
115 (215)
120 (175)
Legend:
AM Traffic Volume
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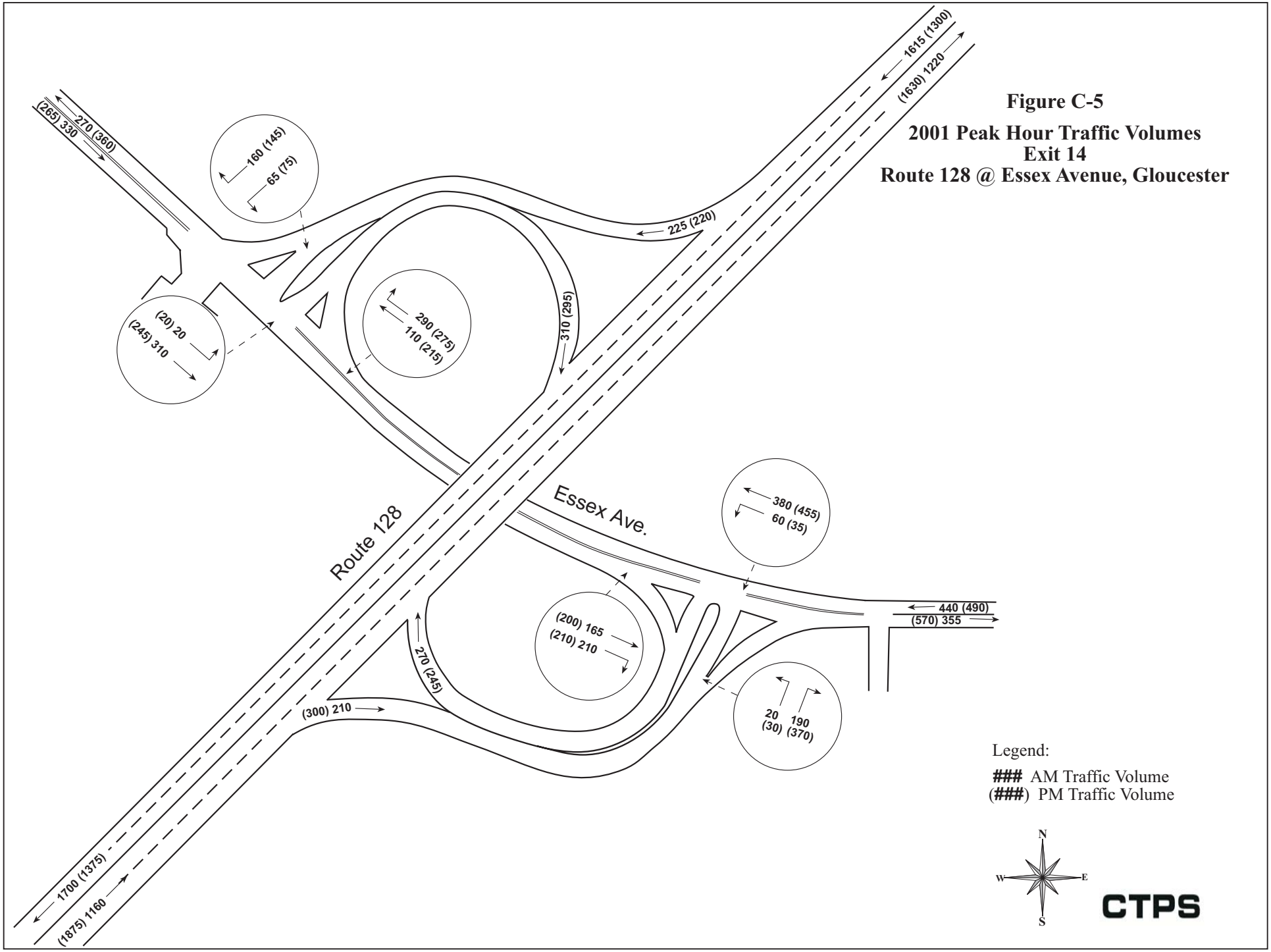
Figure C-5
2001 Peak Hour Traffic Volumes
Exit 14
Route 128 @ Essex Avenue, Gloucester
Route 128
Essex Ave.
1615 (1300)
(1630) 1220
270 (360)
(265) 330
160 (145)
65 (75)
225 (220)
310 (295)
290 (275)
110 (215)
(20) 20
(245) 310
380 (455)
60 (35)
440 (490)
(570) 355
(200) 165
(210) 210
270 (245)
(300) 210
20
(30)
190
(370)
1700 (1375)
(1875) 1160
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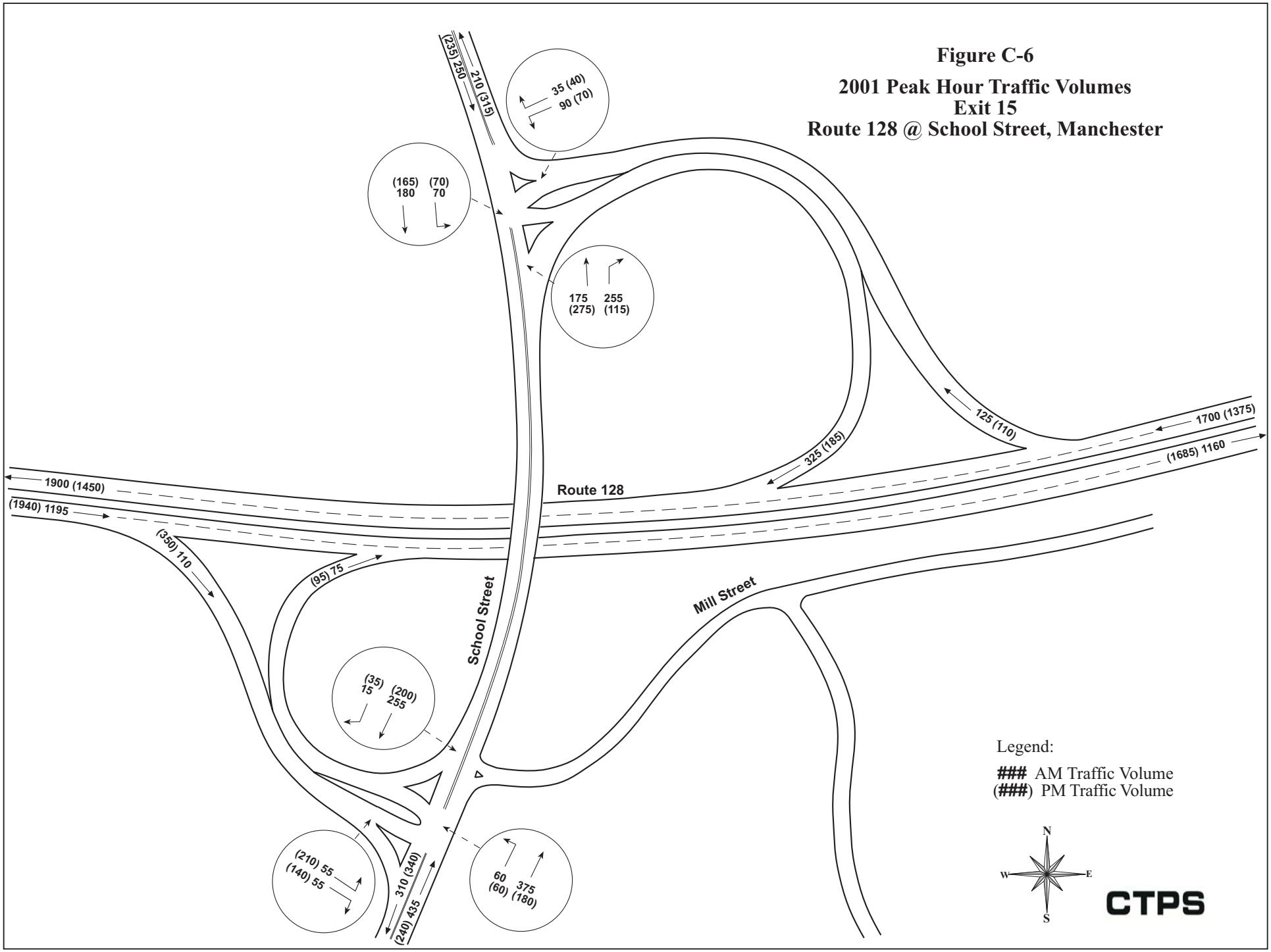
Figure C-6
2001 Peak Hour Traffic Volumes
Exit 15
Route 128 @ School Street, Manchester
(235) 250
210 (315)
35 (40)
90 (70)
(165) 180
(70) 70
175 (275)
255 (115)
125 (110)
1700 (1375)
(1685) 1160
325 (185)
1900 (1450)
(1940) 1195
Route 128
(350) 110
(95) 75
School Street
Mill Street
(35) 15
(200) 255
(210) 55
(140) 55
310 (340)
(240) 435
60 (60)
375 (180)
Legend:
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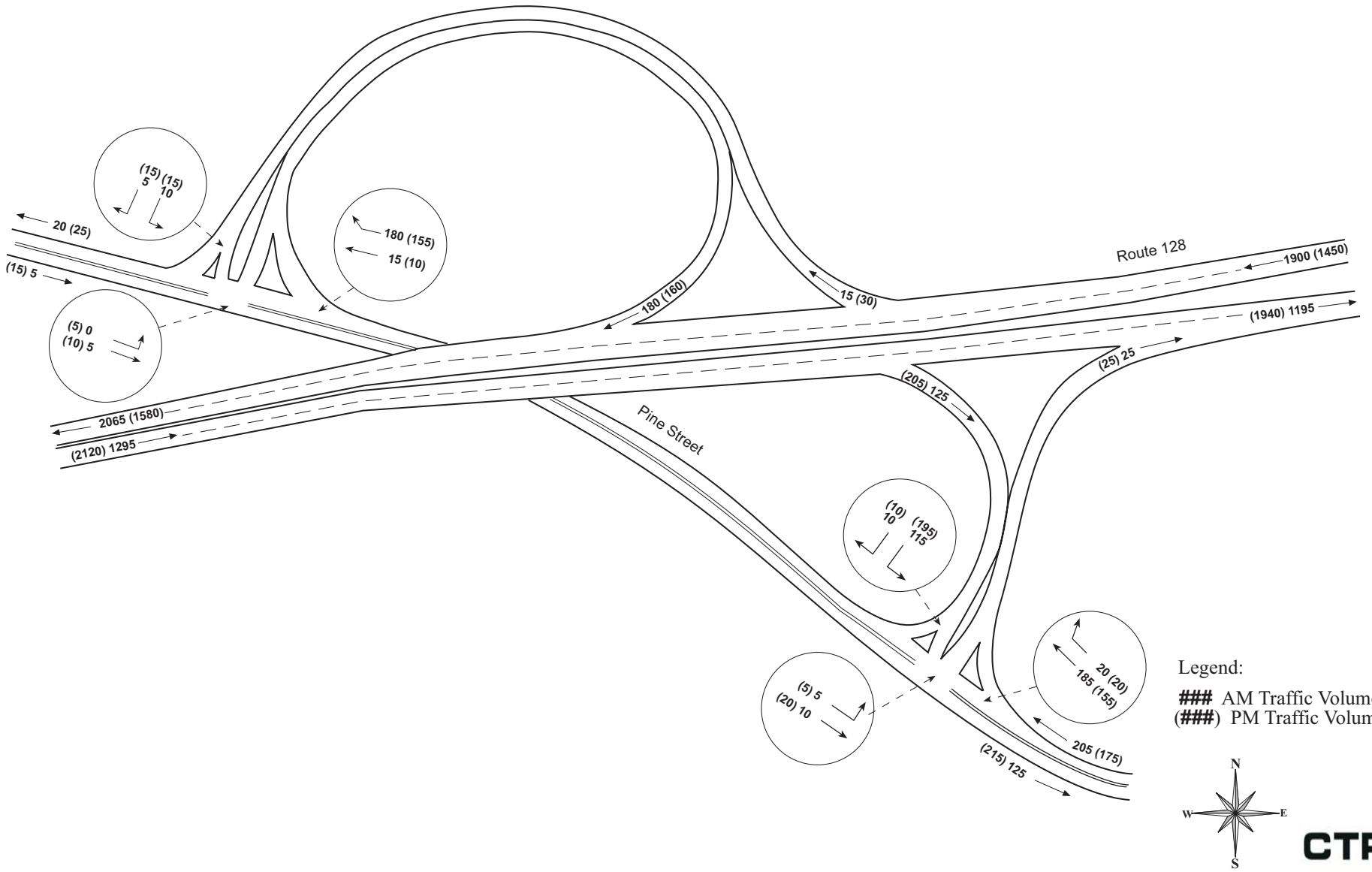
Figure C-7

2001 Peak Hour Traffic Volumes
Exit 16
Route 128 @ Pine Street, Manchester



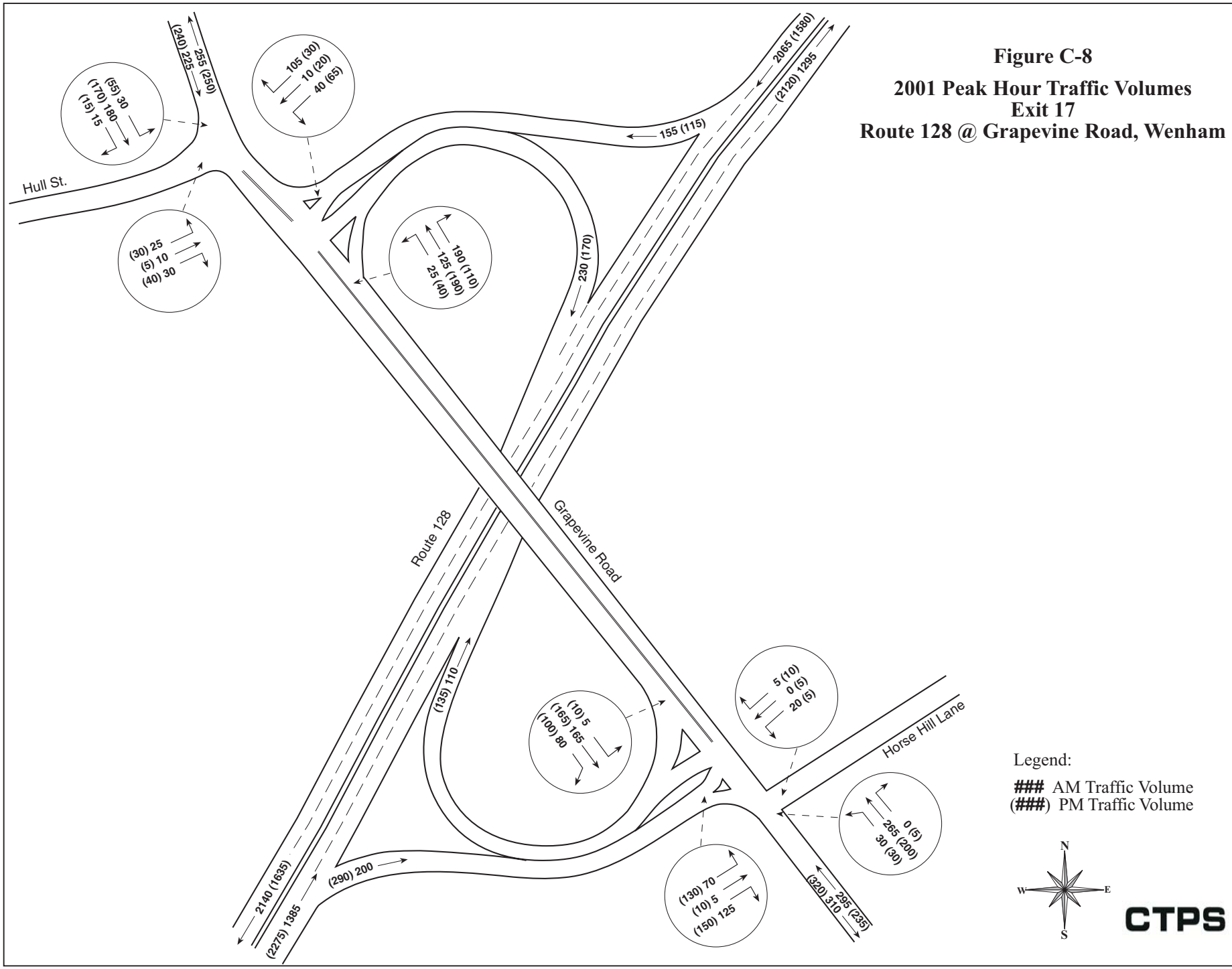


Figure C-8

2001 Peak Hour Traffic Volumes
Exit 17
Route 128 @ Grapevine Road, Wenham

Figure C-9

2001 Peak Hour Traffic Volumes
Exit 18
Route 128 @ Essex Street, Beverly

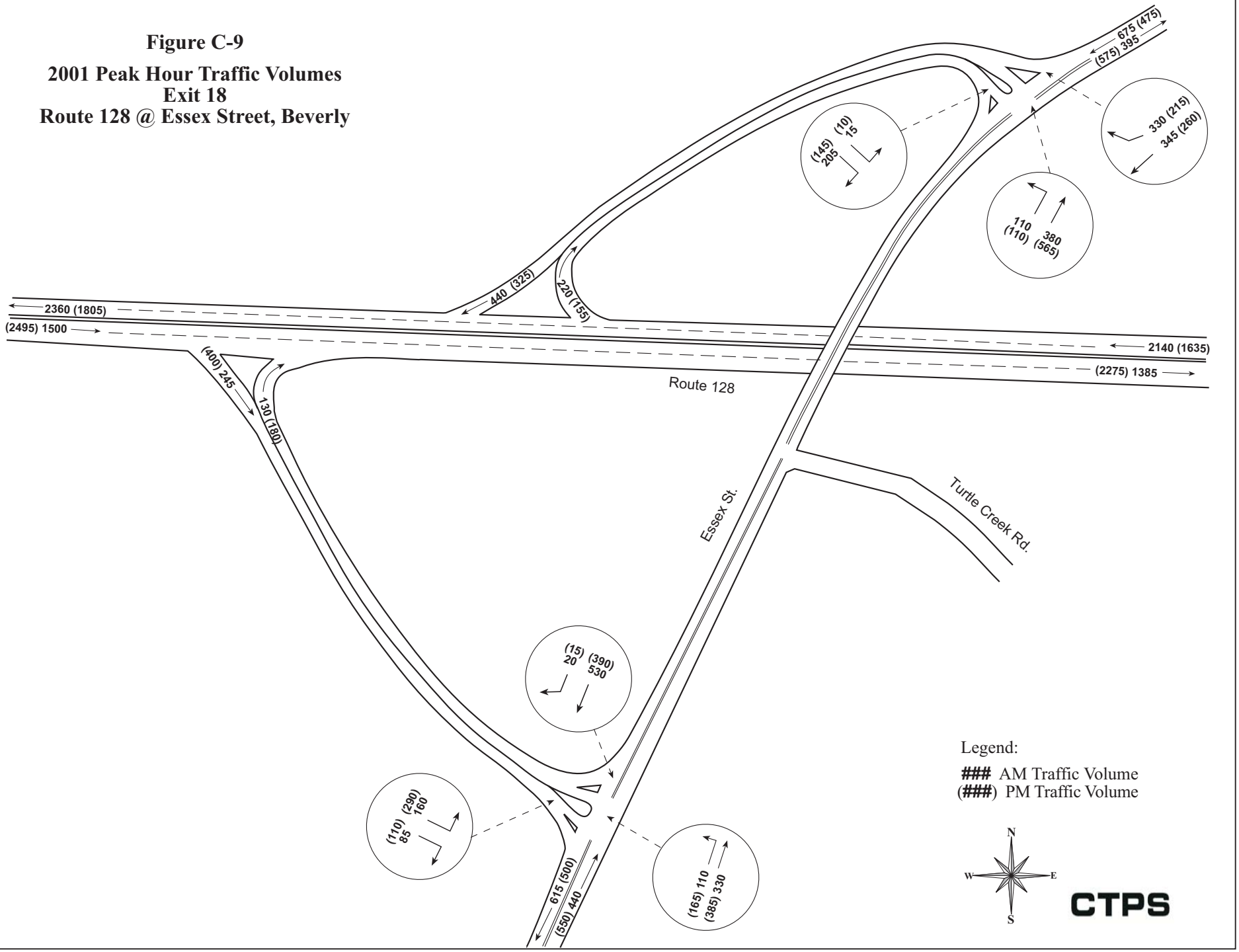


Figure C-10

2001 Peak Hour Traffic Volumes
Exit 19
Route 128 @ Brimbal Avenue, Beverly

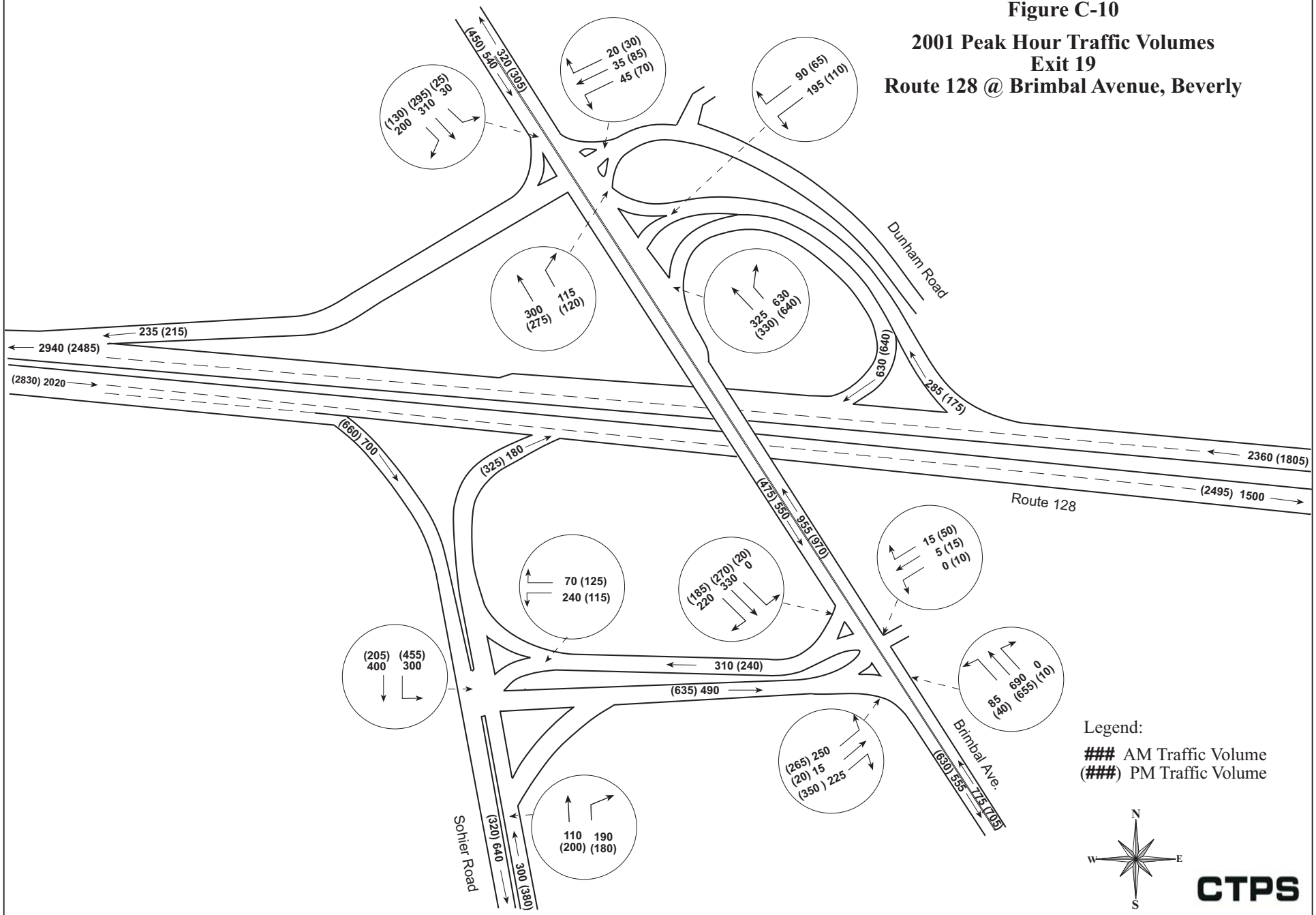
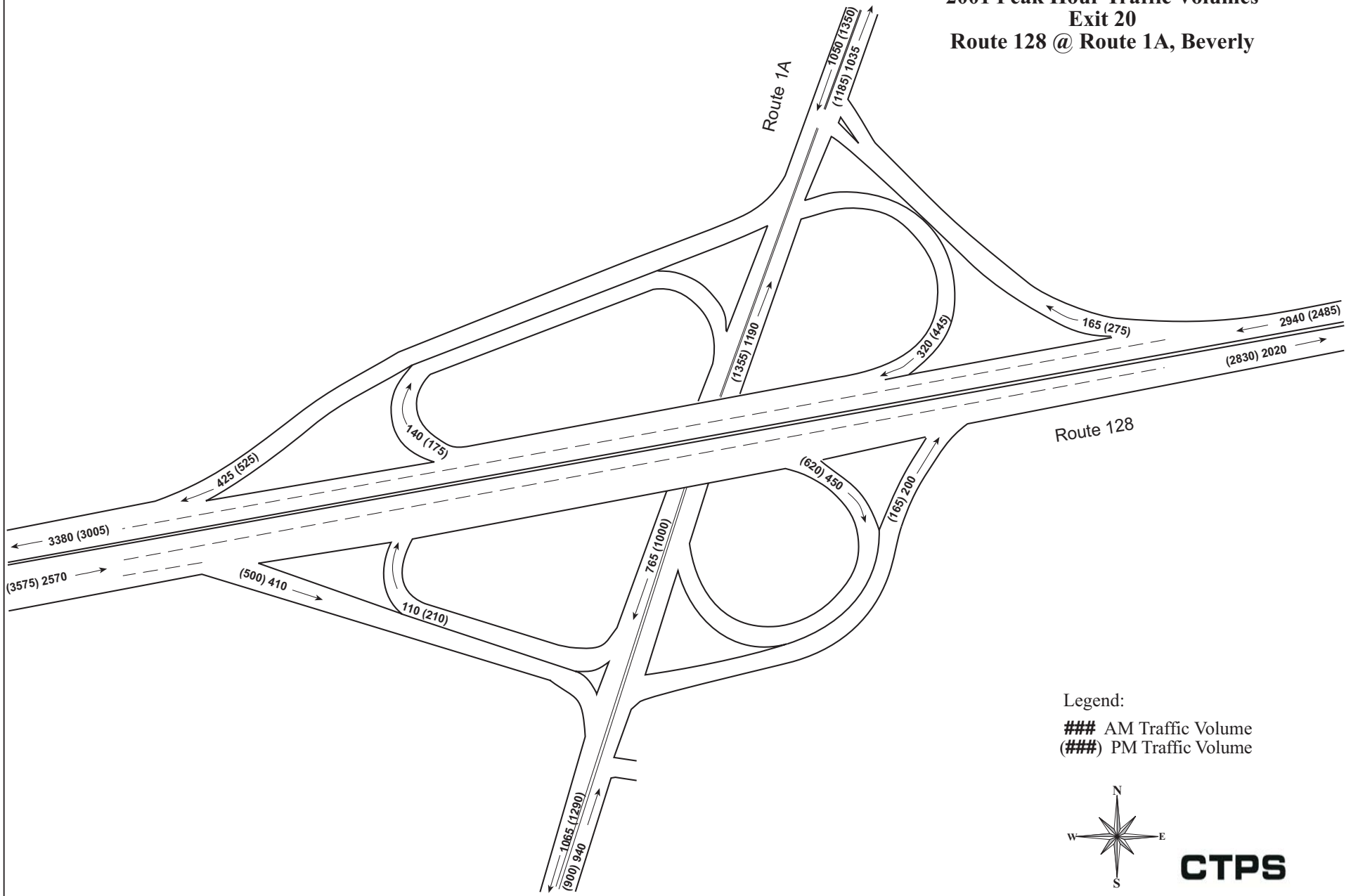


Figure C-11

2001 Peak Hour Traffic Volumes
Exit 20
Route 128 @ Route 1A, Beverly



Legend:

AM Traffic Volume
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APPENDIX D

Base Year (2001) Interchange Capacity Analyses

Figure D-1

2001 Peak Hour Capacity Analysis
Exit 10
Route 128 @ Blackburn Circle, Gloucester

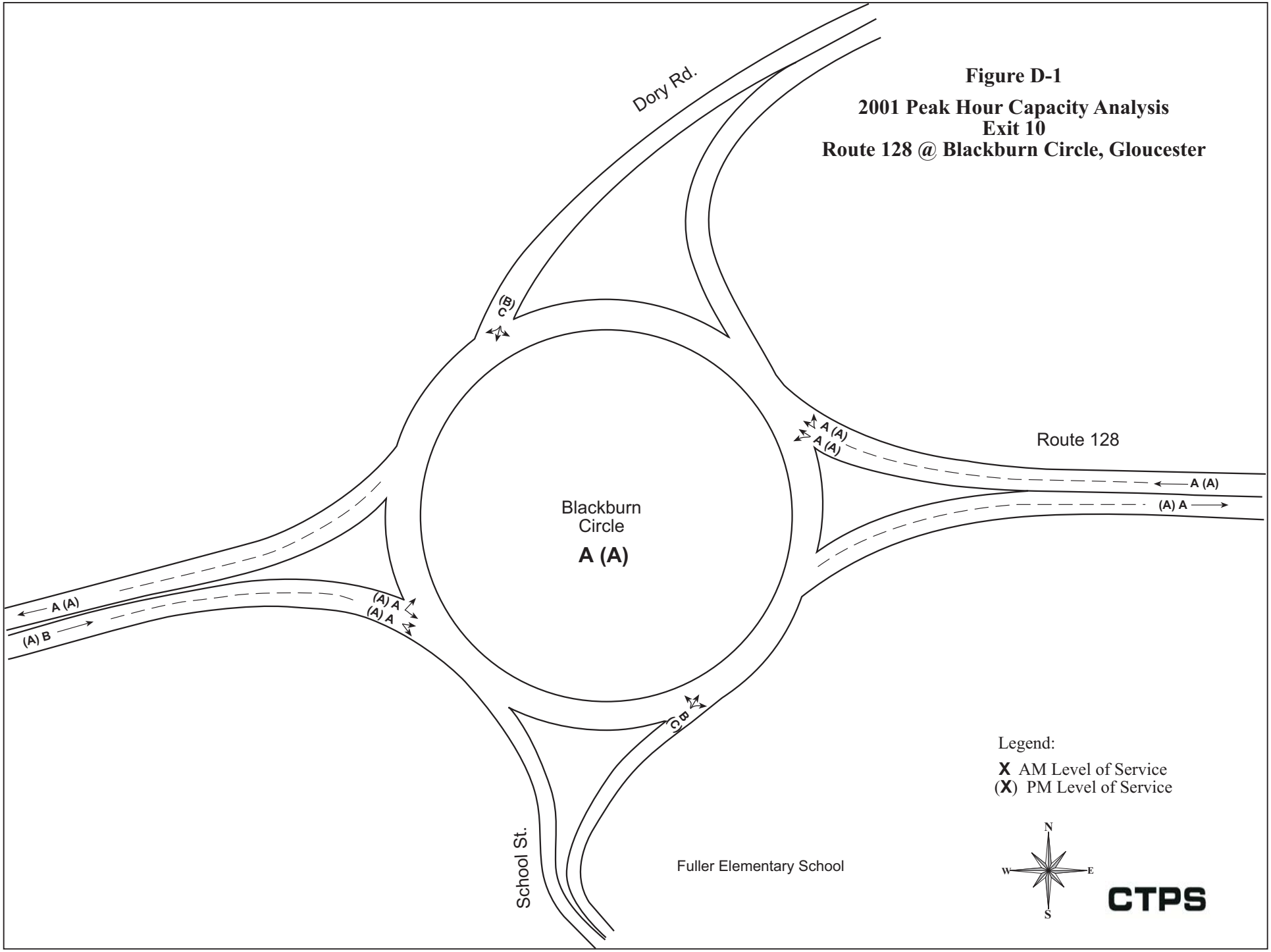


Figure D-2

2001 Peak Hour Capacity Analysis
Exit 11
Route 128 @ Grant Circle, Gloucester

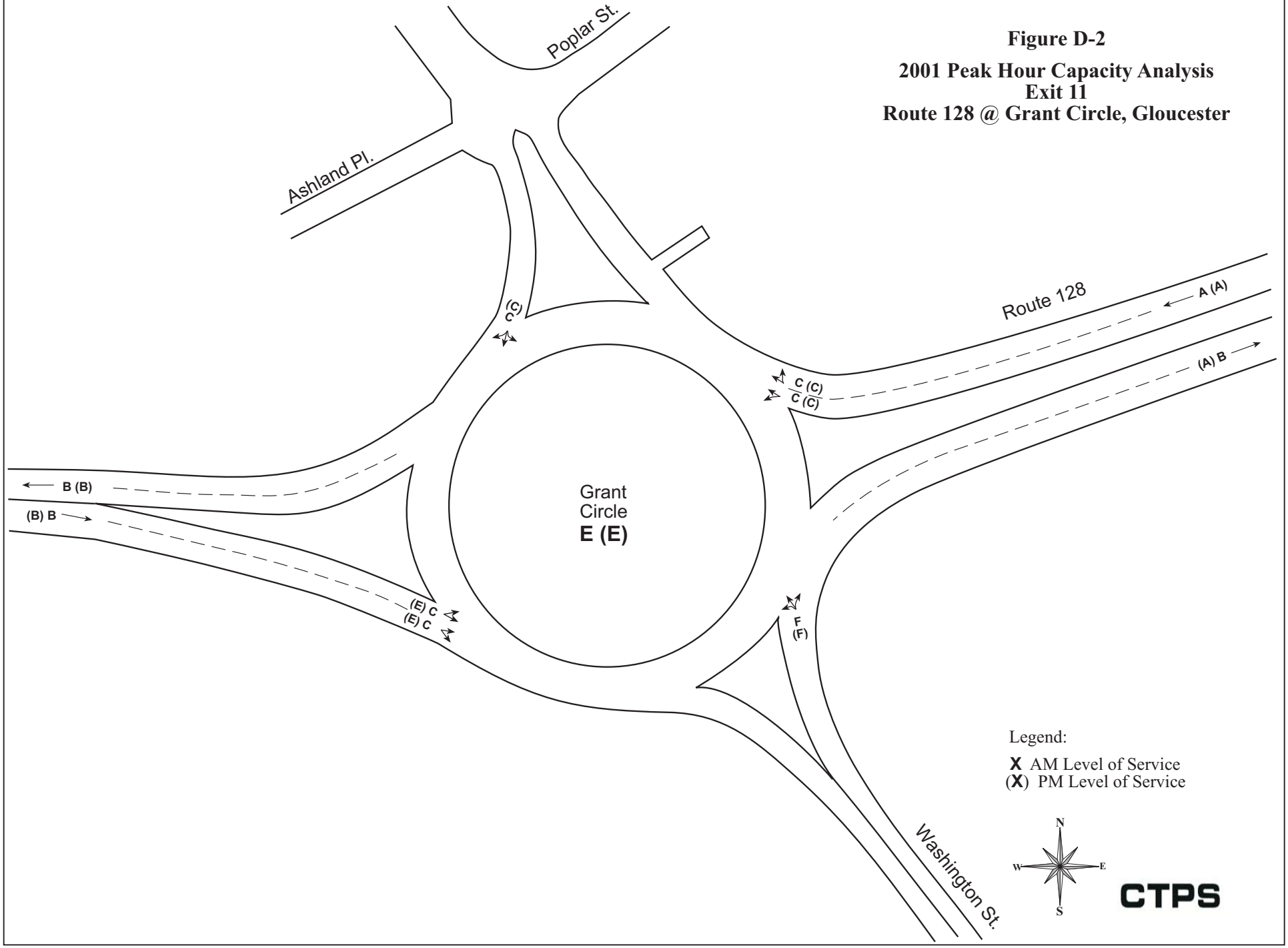


Figure D-3

2001 Peak Hour Capacity Analysis
Exit 12
Route 128 @ Craft's Road, Gloucester

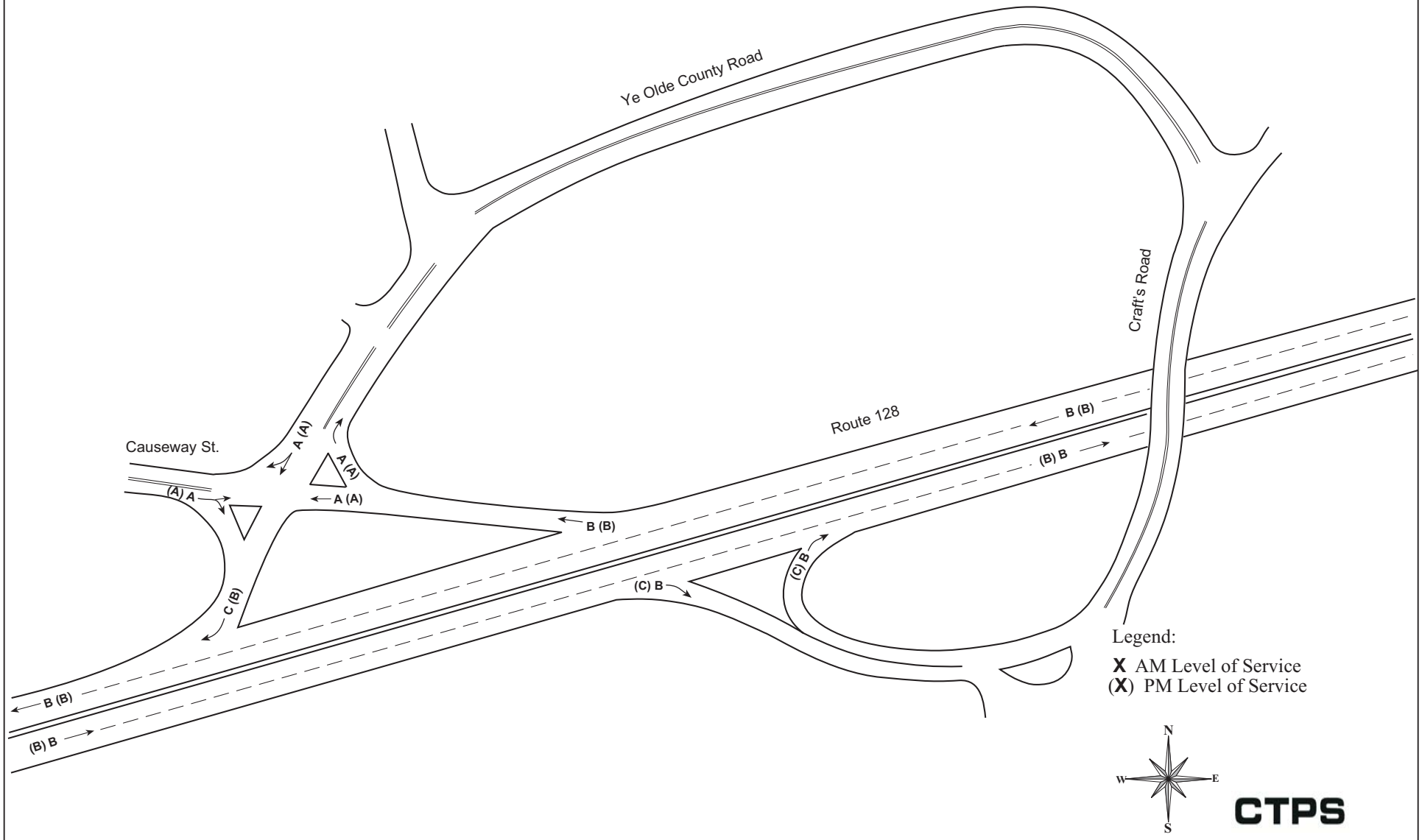
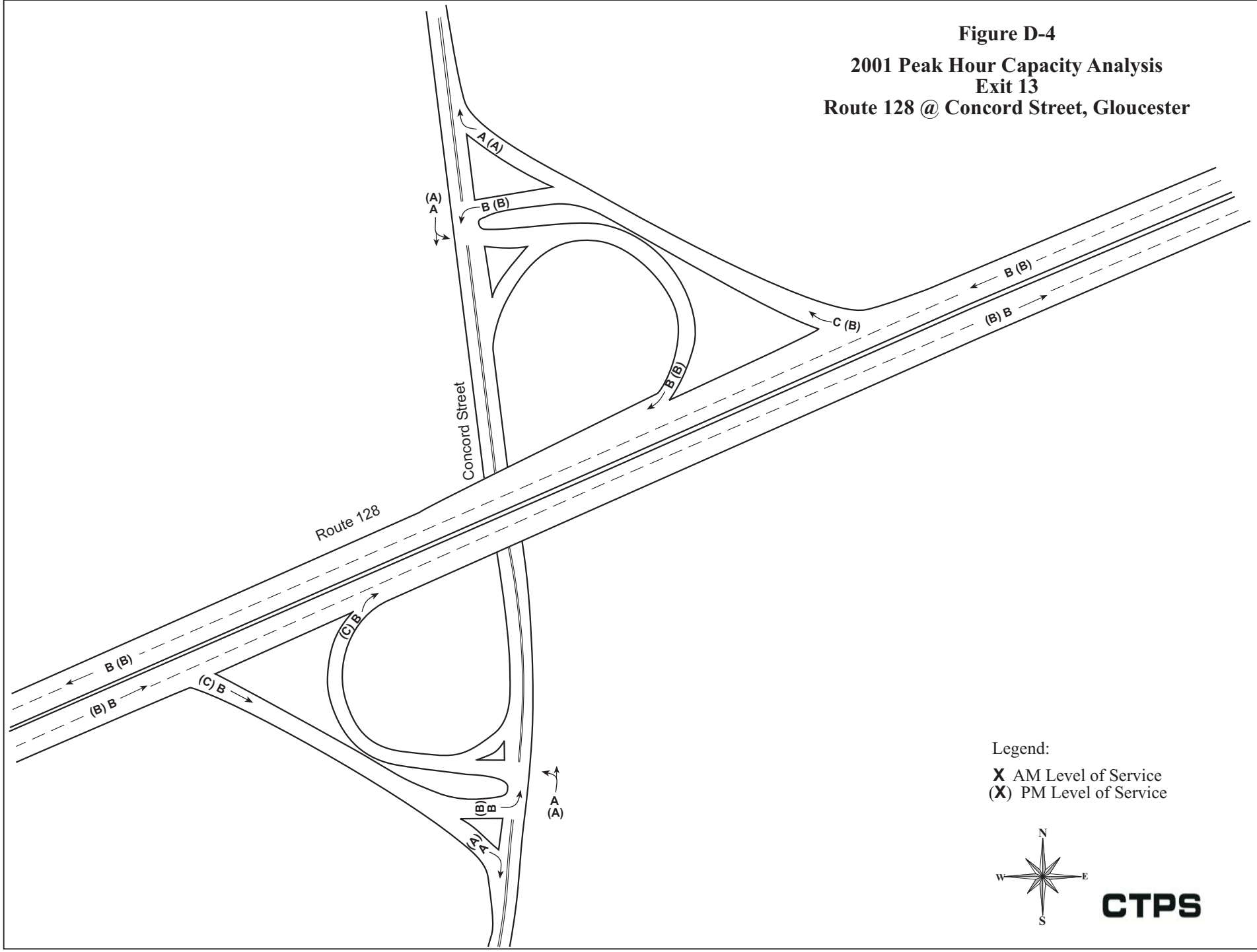


Figure D-4

2001 Peak Hour Capacity Analysis
Exit 13
Route 128 @ Concord Street, Gloucester



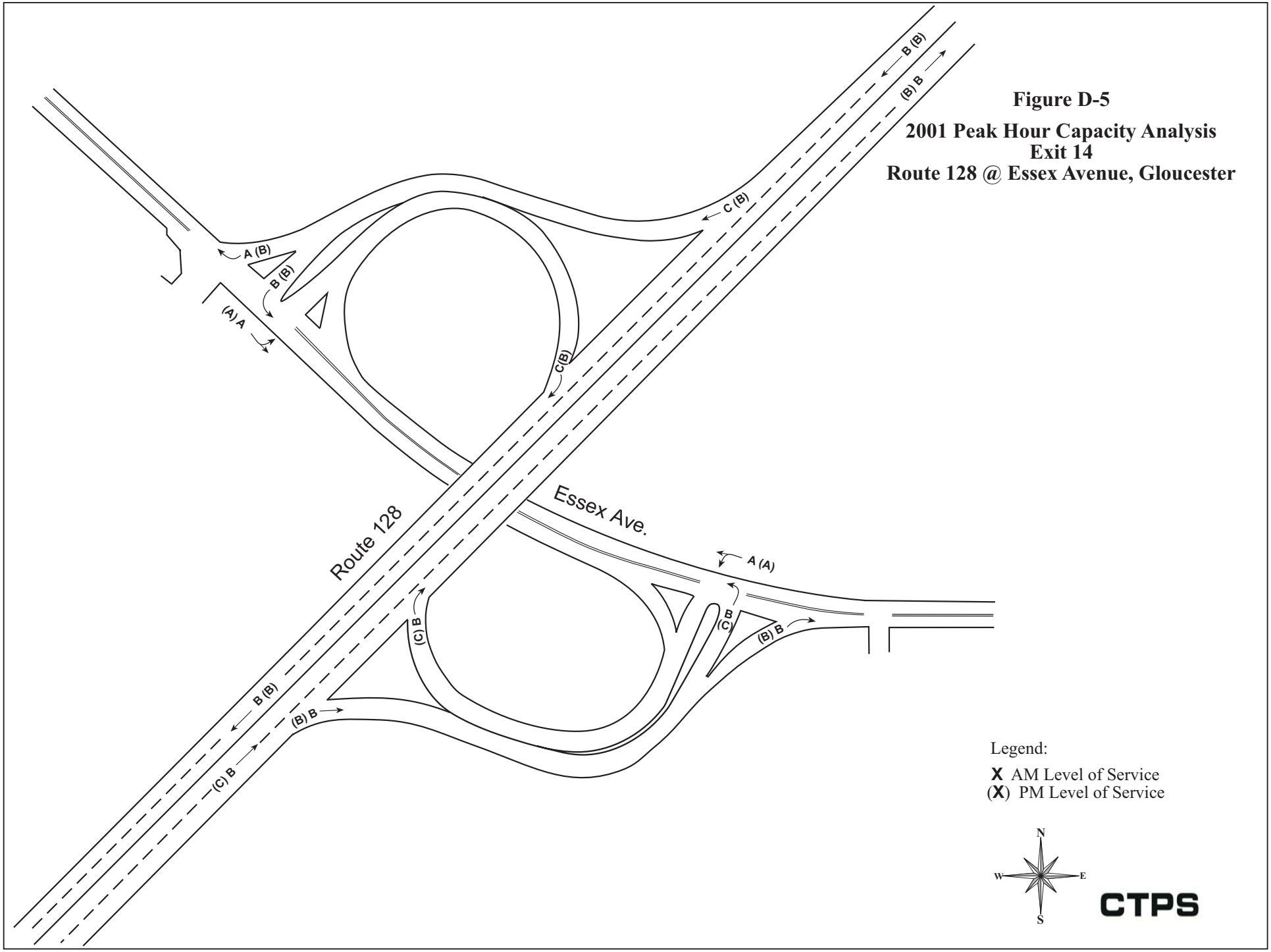


Figure D-5
2001 Peak Hour Capacity Analysis
Exit 14
Route 128 @ Essex Avenue, Gloucester
B (B)
(B) B
C (B)
A (B)
B (B)
(A) A
C(B)
Route 128
Essex Ave.
A (A)
B (C)
(C) B
(B) B
B (B)
(B) B
(C) B
Legend:
X AM Level of Service
(X) PM Level of Service
N
W
E
S
CTPS

Figure D-6

2001 Peak Hour Capacity Analysis
Exit 15
Route 128 @ School Street, Manchester

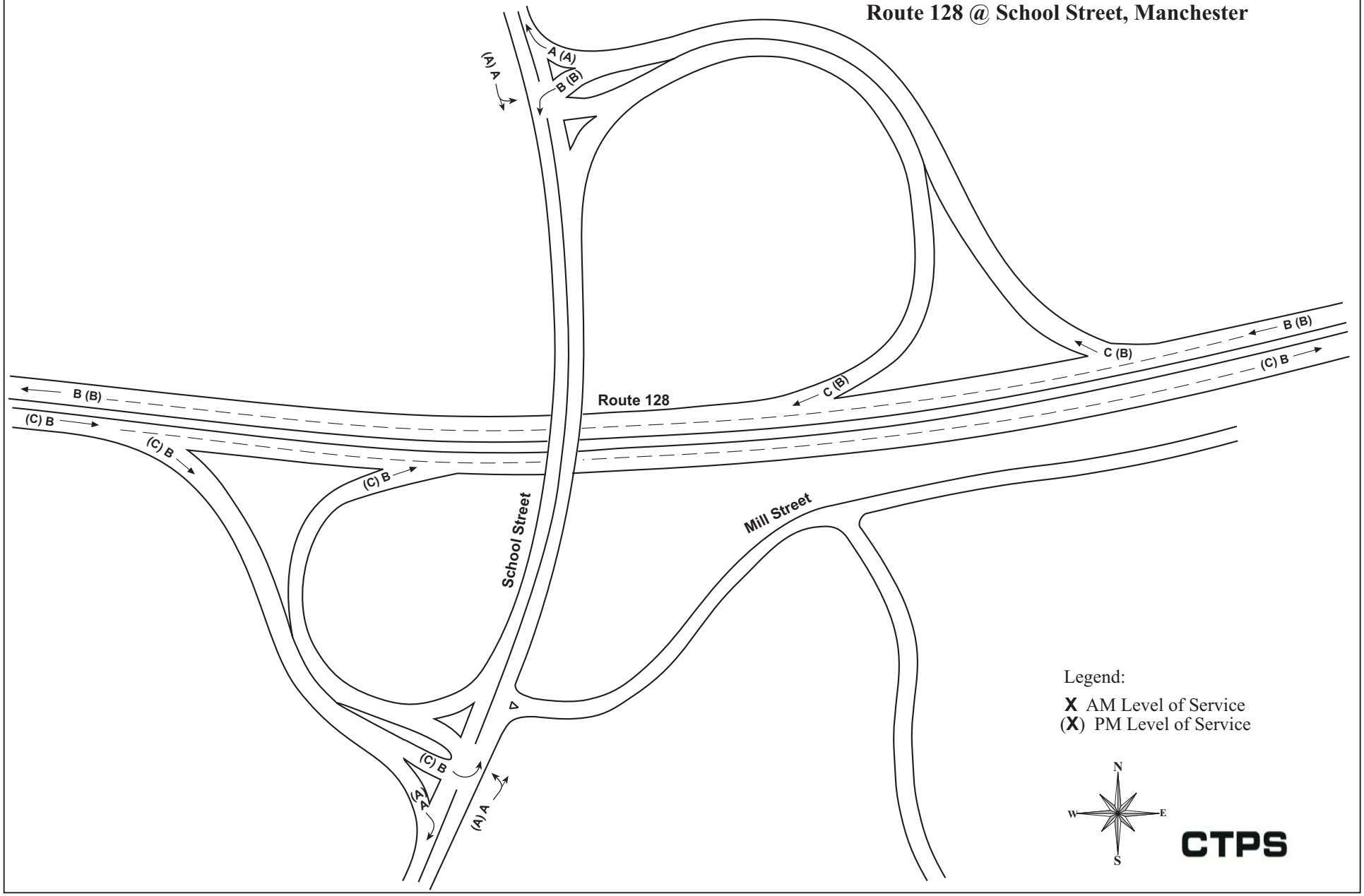


Figure D-7

2001 Peak Hour Capacity Analysis
Exit 16
Route 128 @ Pine Street, Manchester

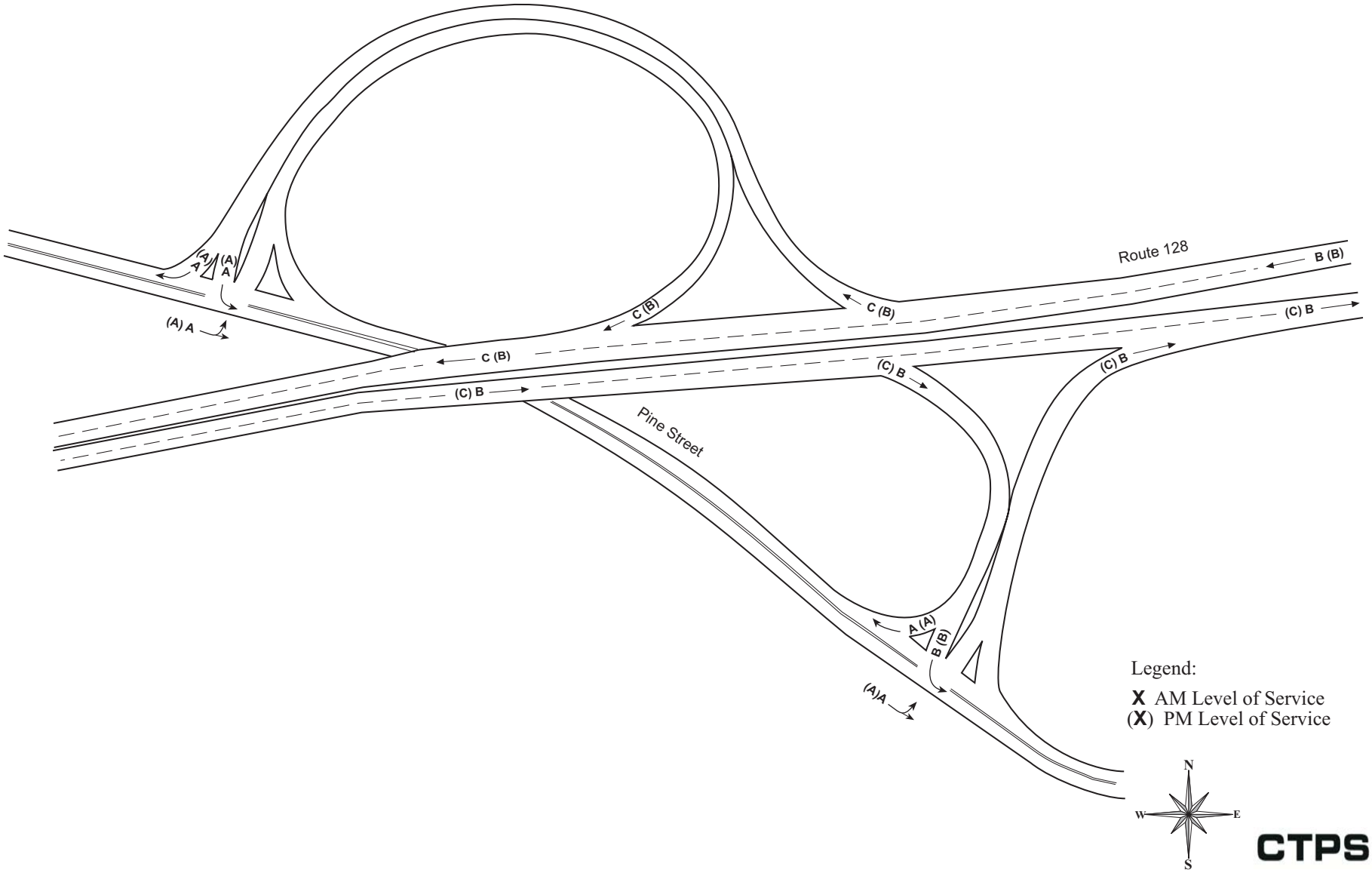
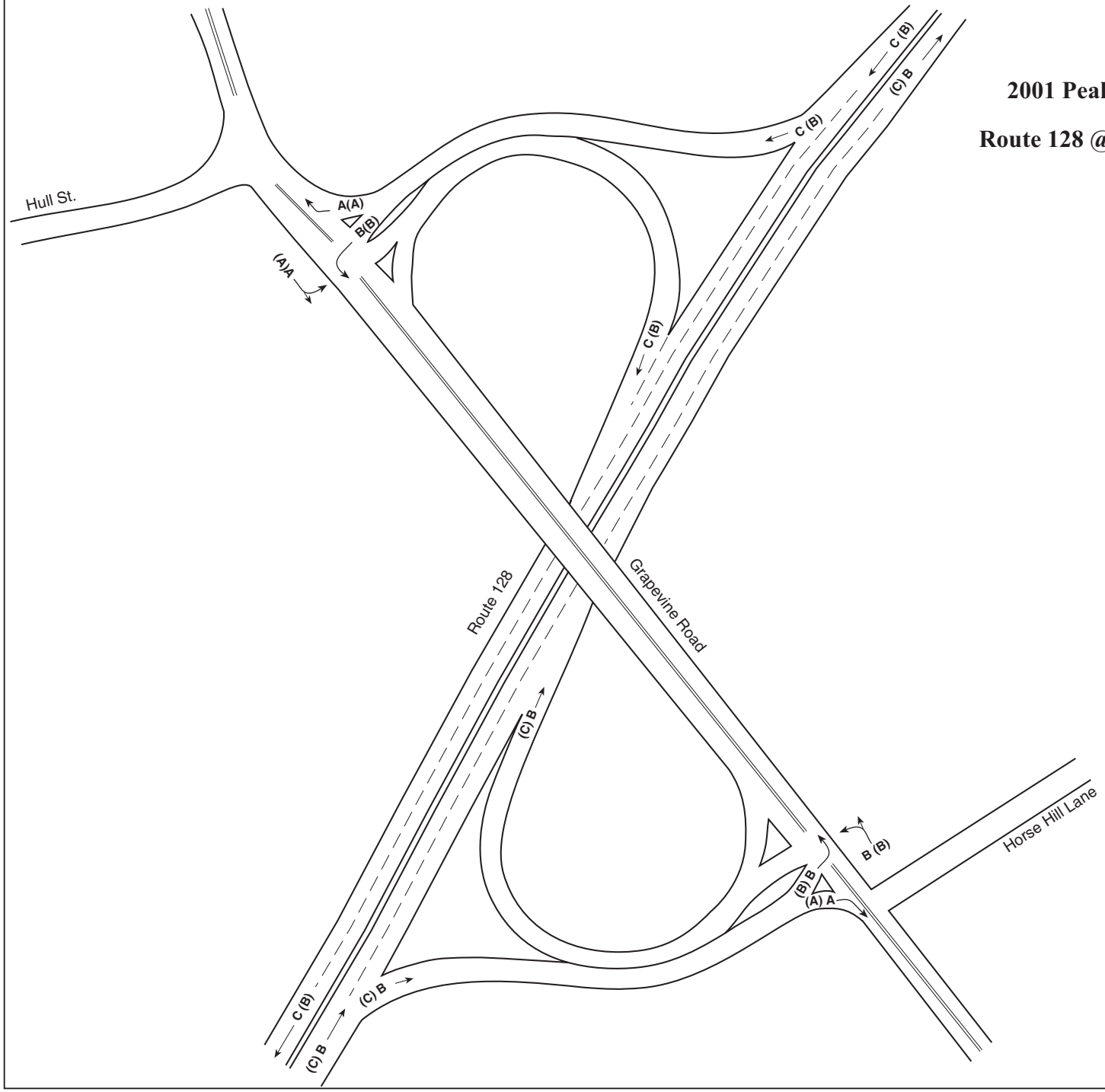


Figure D-8

2001 Peak Hour Capacity Analysis
Exit 17
Route 128 @ Grapevine Road, Wenham



Legend:

X AM Level of Service
(**X**) PM Level of Service

N
W
E
S

CTPS

Figure D-9

2001 Peak Hour Capacity Analysis
Exit 18
Route 128 @ Essex Street, Beverly

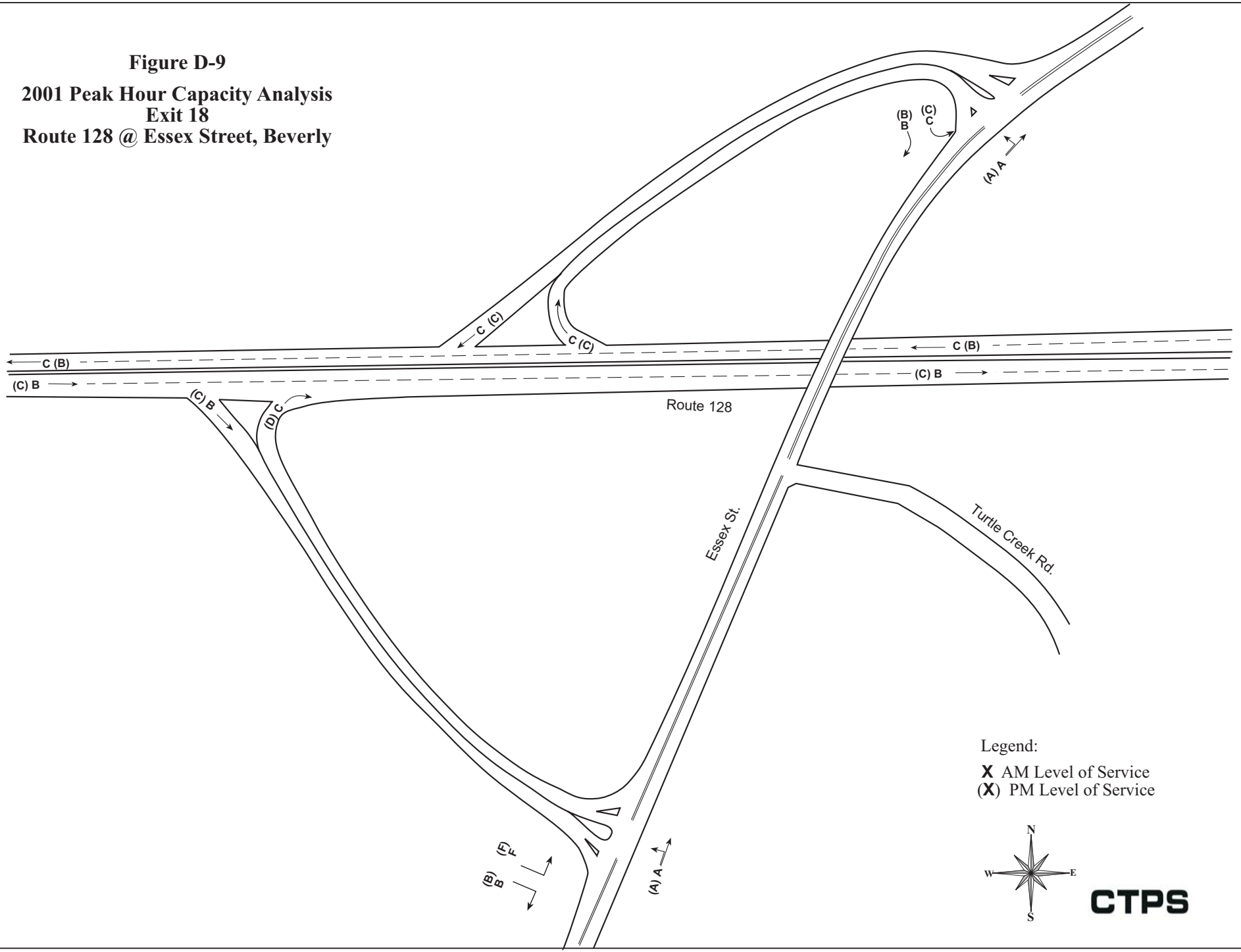


Figure D-10

2001 Peak Hour Capacity Analysis
Exit 19
Route 128 @ Brimbal Avenue, Beverly

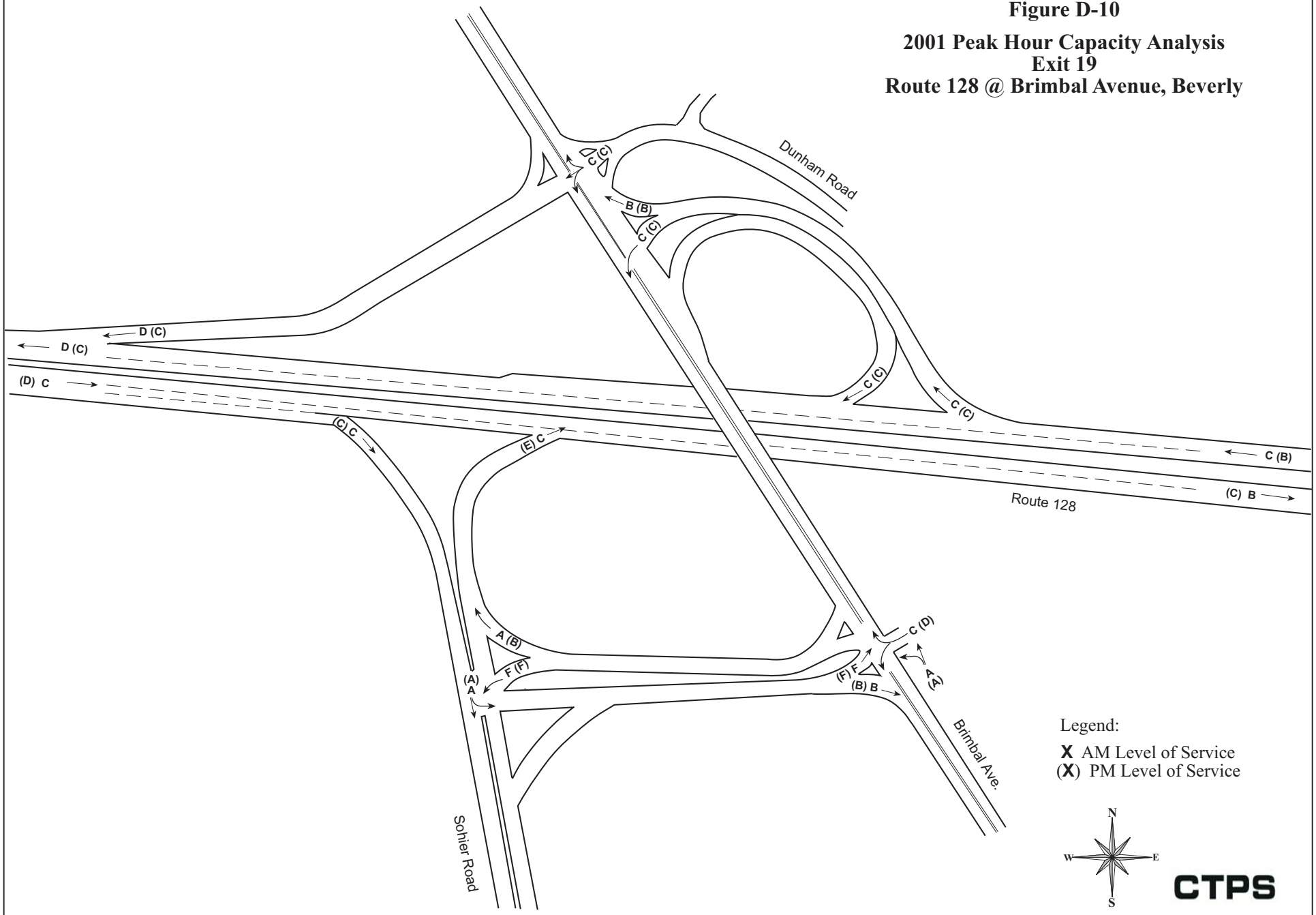
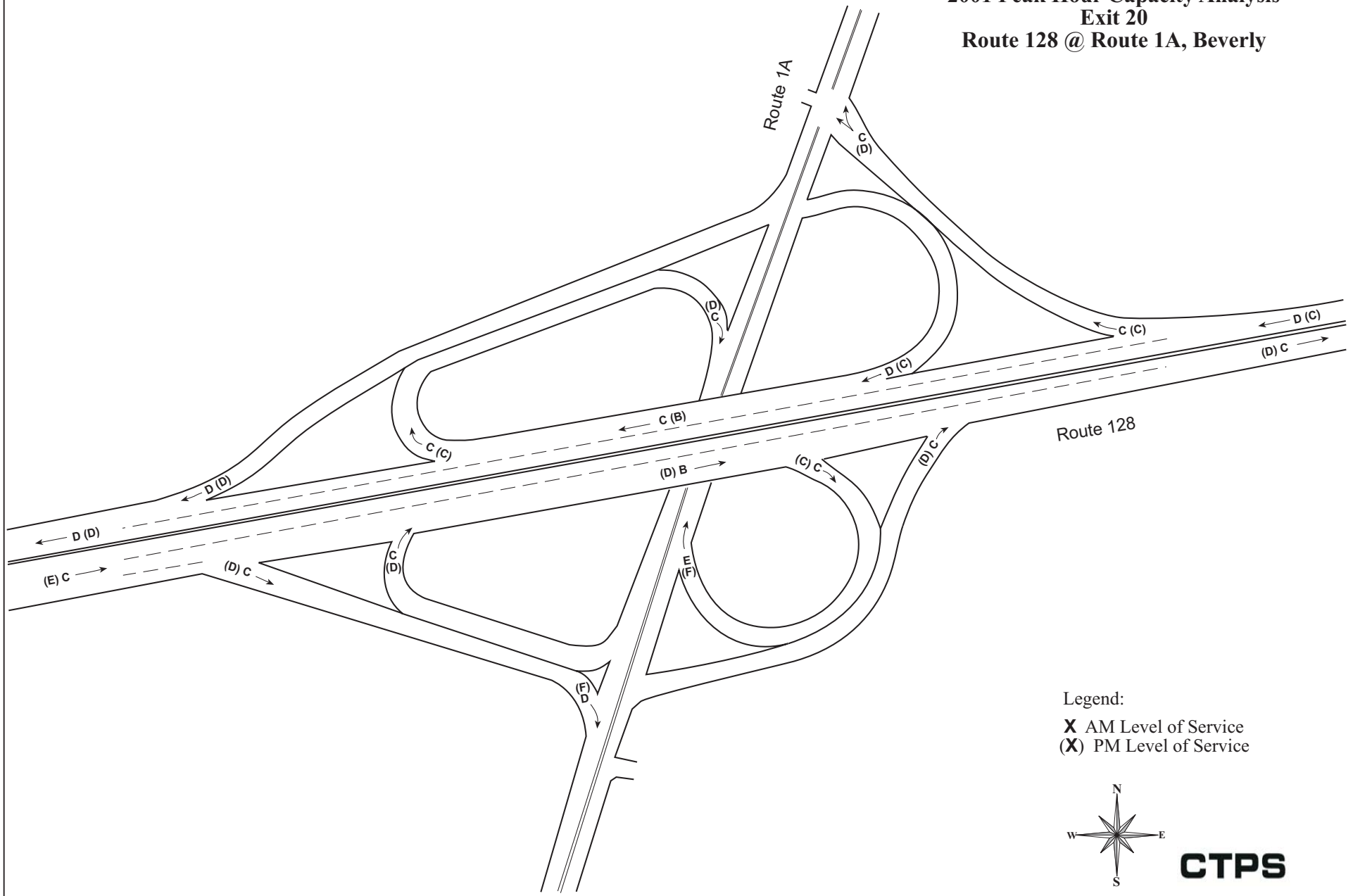


Figure D-11

2001 Peak Hour Capacity Analysis
Exit 20
Route 128 @ Route 1A, Beverly



Legend:

X AM Level of Service
(**X**) PM Level of Service

N
W
E
S

CTPS

APPENDIX E

Future (2025) No-Build Peak Period Traffic Volume Forecasts

Figure E-1

2025 Peak Period Traffic Volumes
Exit 10
Route 128 @ Blackburn Circle, Gloucester

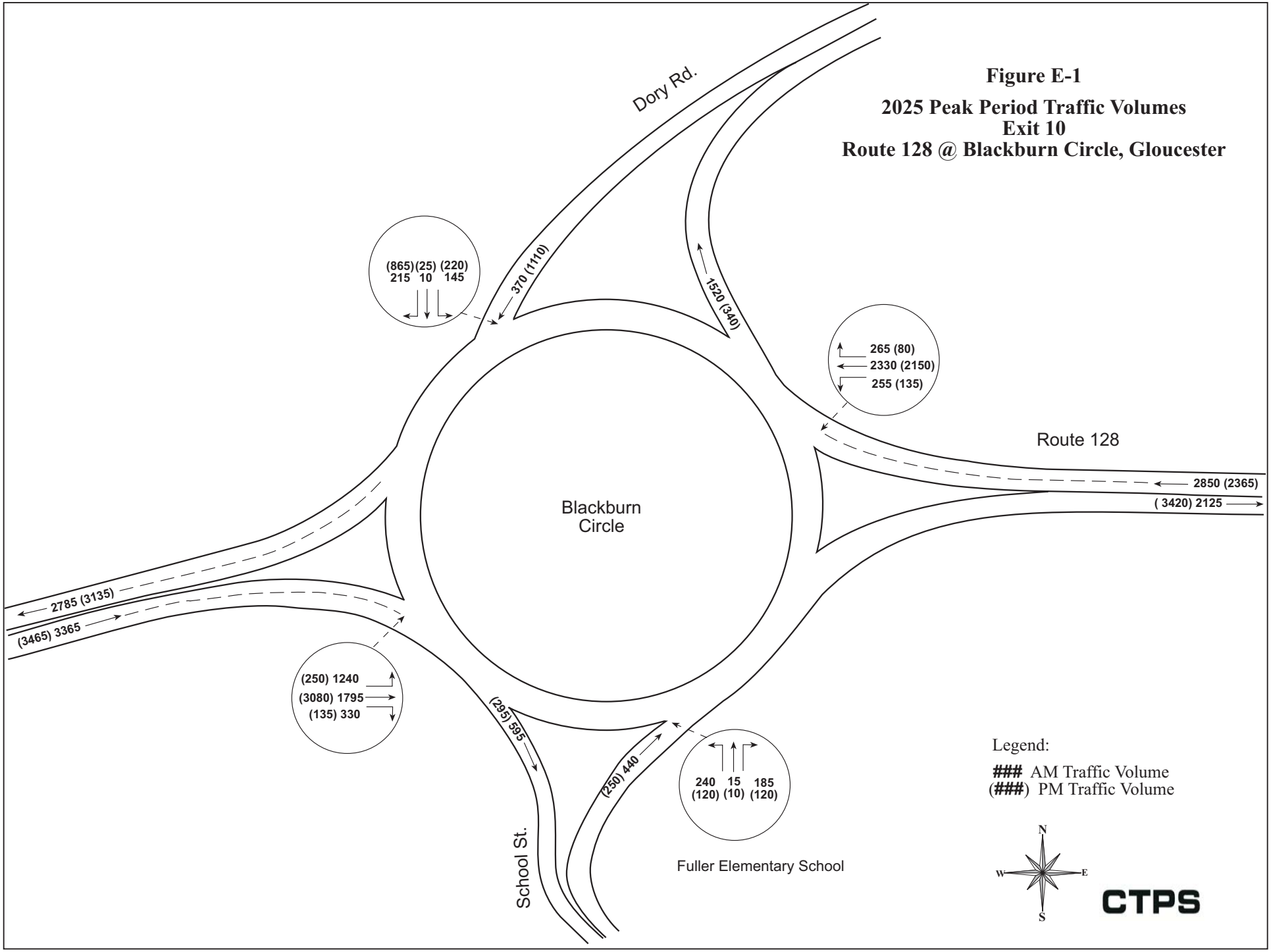


Figure E-2

2025 Peak Period Traffic Volumes
Exit 11
Route 128 @ Grant Circle, Gloucester

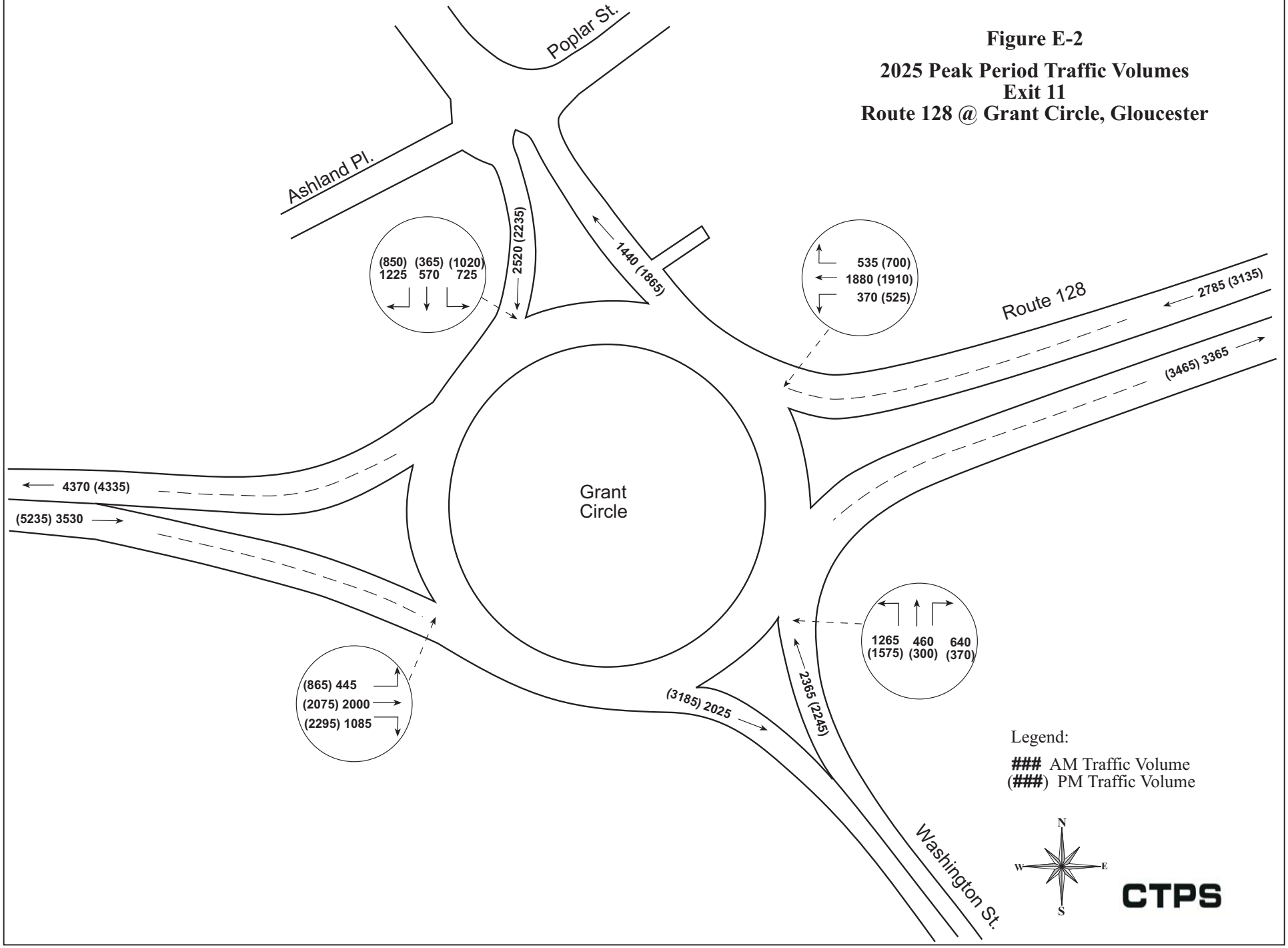


Figure E-3

2025 Peak Period Traffic Volumes
Exit 12
Route 128 @ Craft's Road, Gloucester

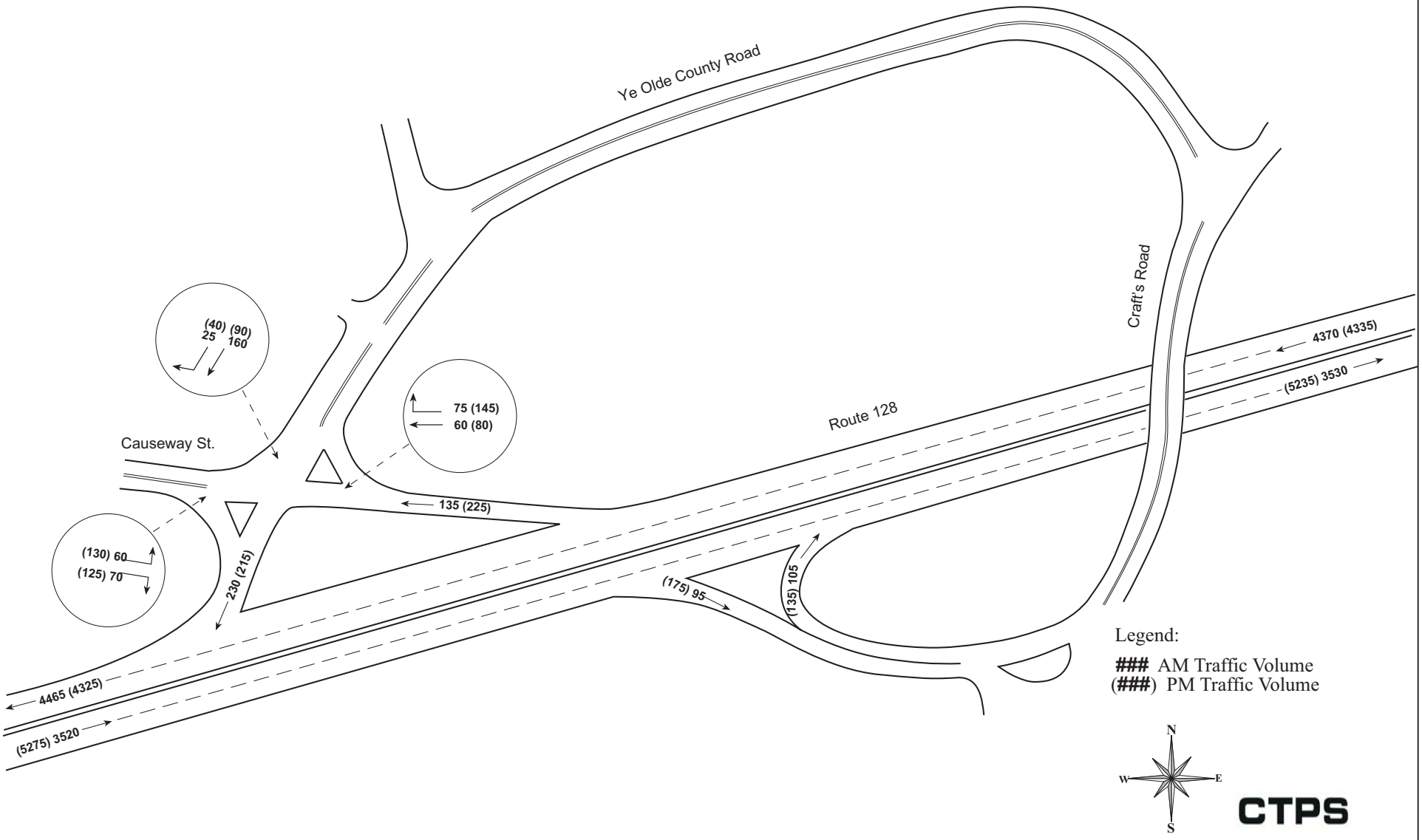
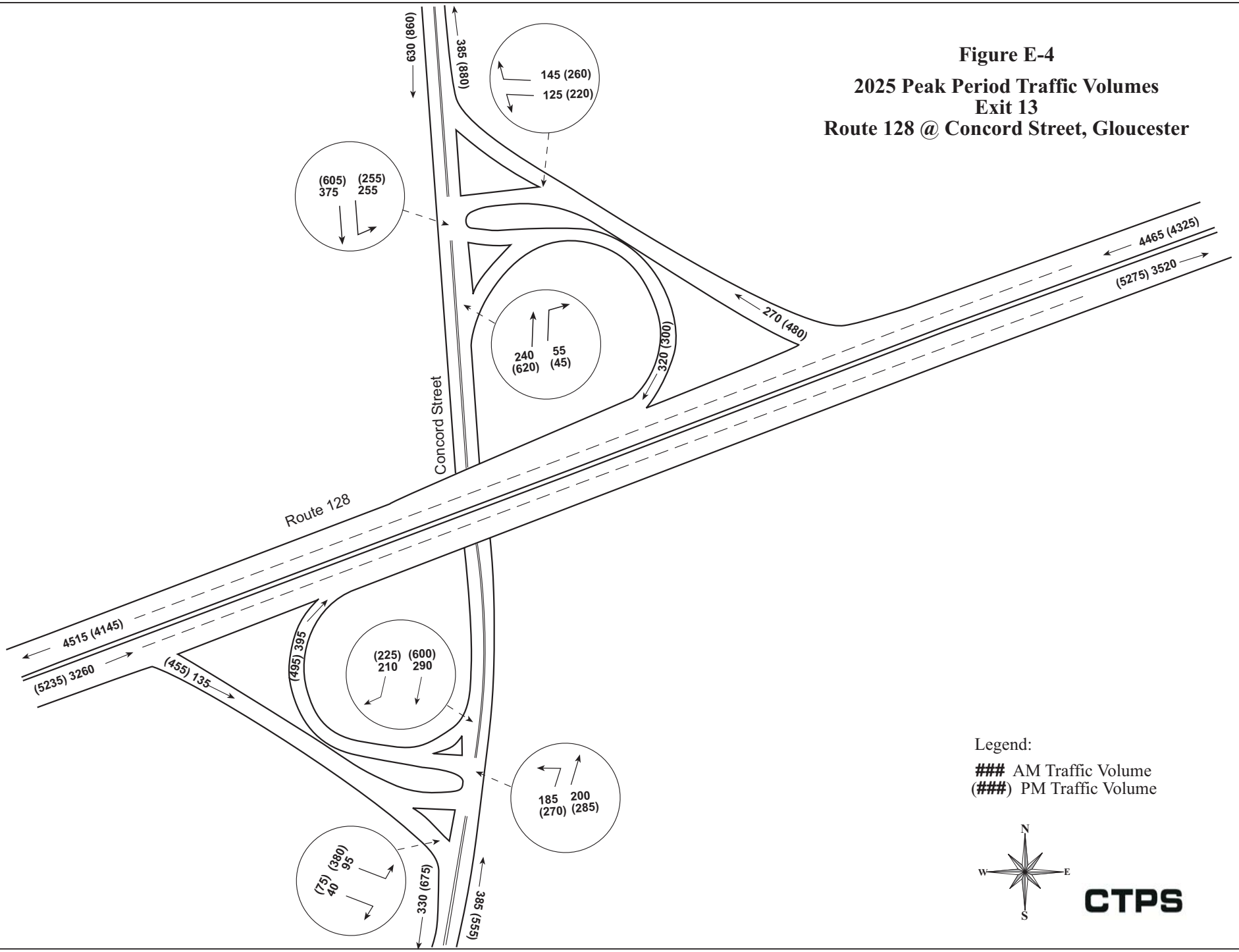


Figure E-4

2025 Peak Period Traffic Volumes
Exit 13
Route 128 @ Concord Street, Gloucester



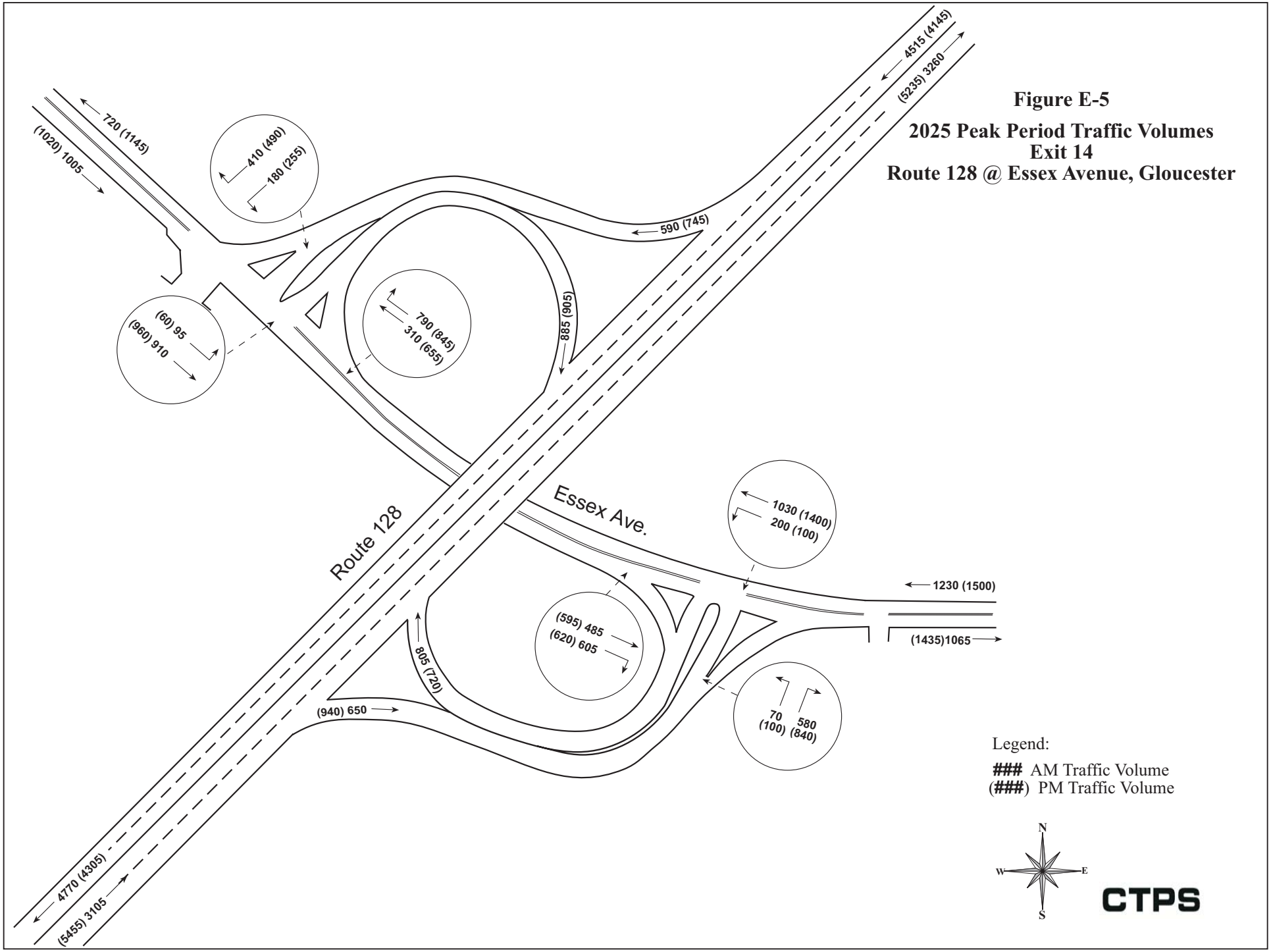


Figure E-5
2025 Peak Period Traffic Volumes
Exit 14
Route 128 @ Essex Avenue, Gloucester
720 (1145)
(1020) 1005
410 (490)
180 (255)
4515 (4145)
(5235) 3260
590 (745)
885 (905)
790 (845)
310 (655)
(60) 95
(960) 910
Route 128
Essex Ave.
1030 (1400)
200 (100)
1230 (1500)
(1435)1065
(595) 485
(620) 605
805 (720)
(940) 650
70
(100)
580
(840)
4770 (4305)
(5455) 3105
Legend:
AM Traffic Volume
(###) PM Traffic Volume
N
W
E
S
CTPS

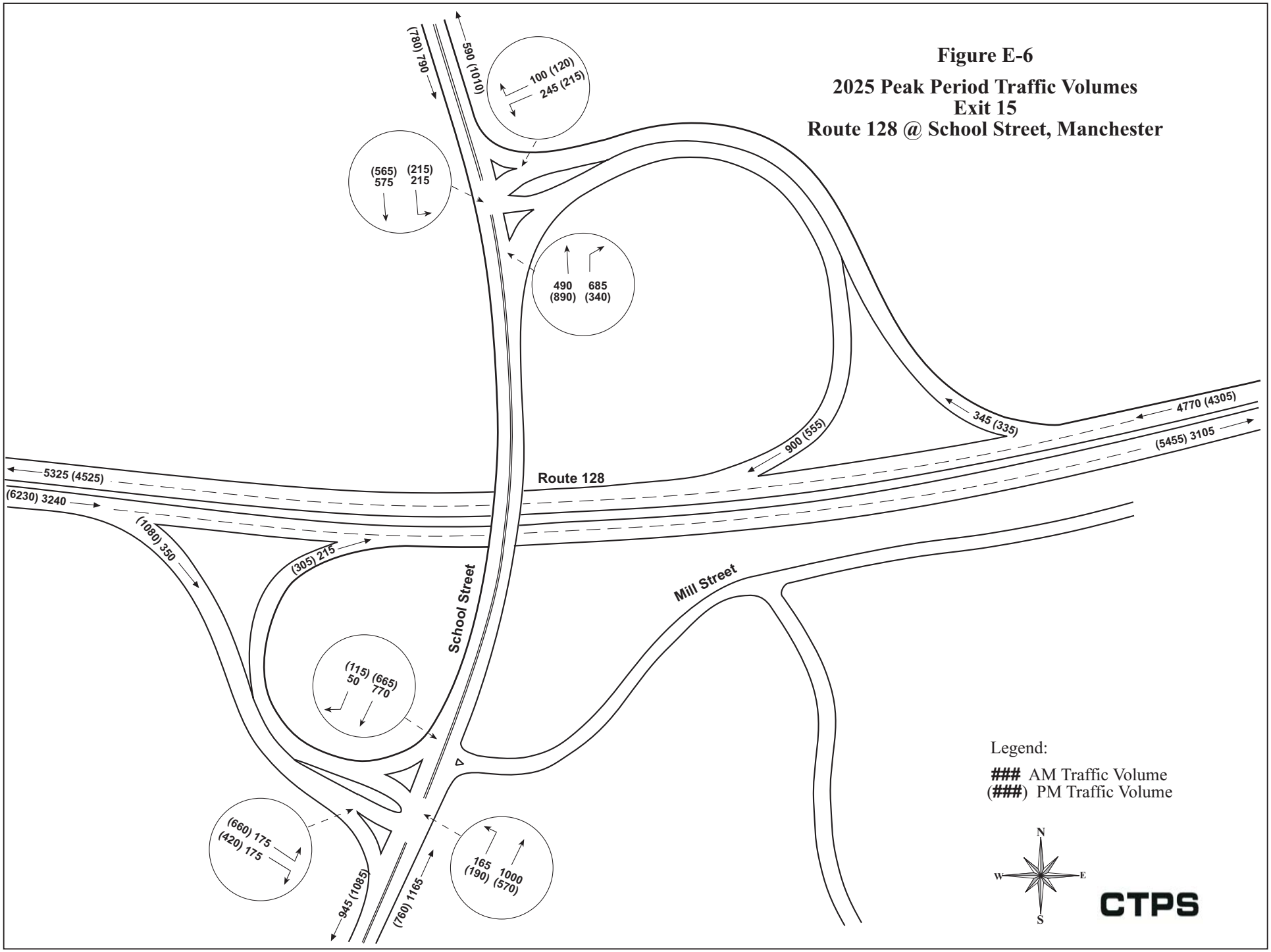
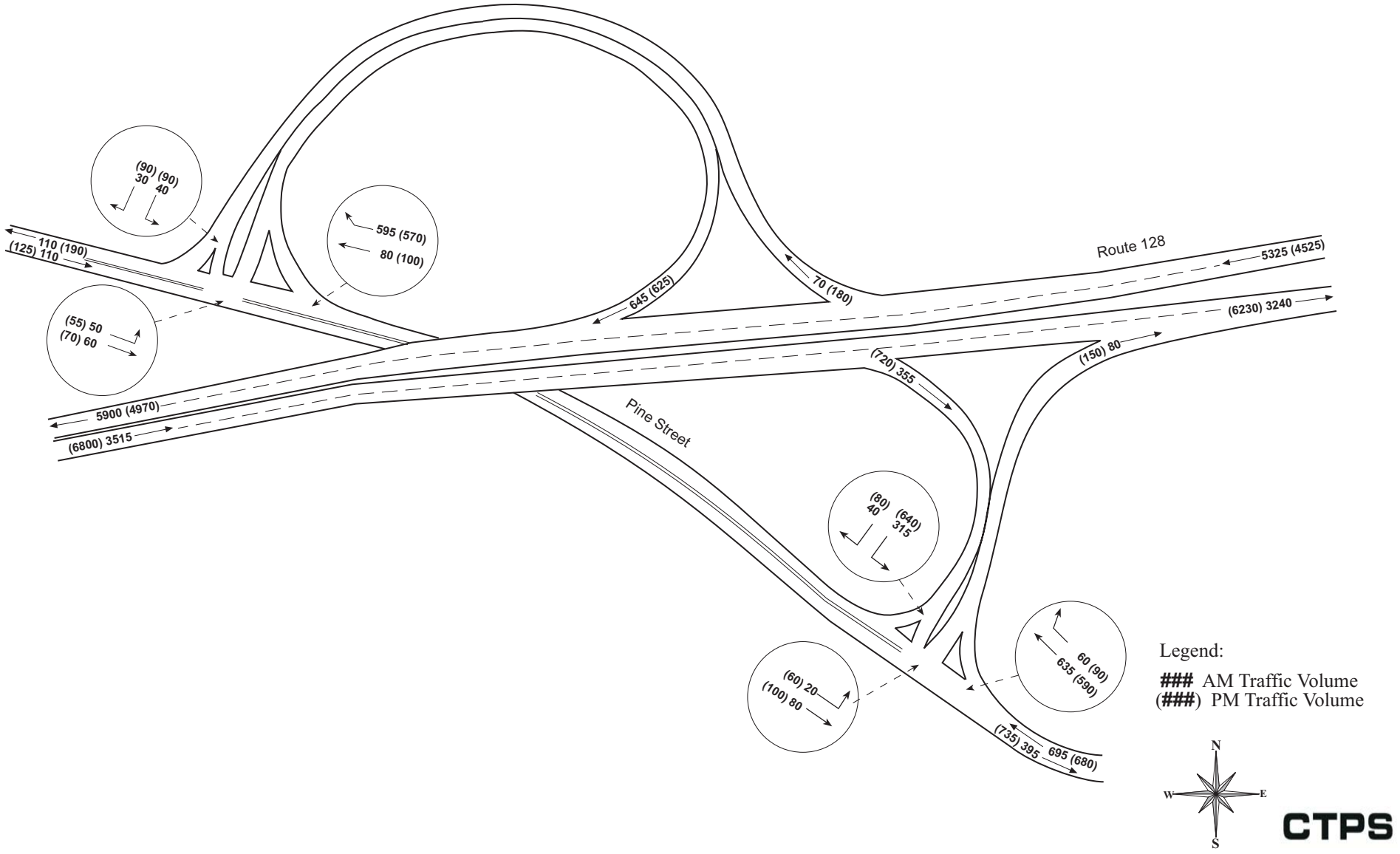


Figure E-6
2025 Peak Period Traffic Volumes
Exit 15
Route 128 @ School Street, Manchester
(780) 790
590 (1010)
100 (120)
245 (215)
(565) 575
(215) 215
490 (890)
685 (340)
345 (335)
4770 (4305)
900 (555)
(5455) 3105
5325 (4525)
Route 128
(6230) 3240
(1080) 350
(305) 215
School Street
Mill Street
(115) 50
(665) 770
(660) 175
(420) 175
945 (1085)
(760) 1165
165 (190)
1000 (570)
Legend:
AM Traffic Volume
(###) PM Traffic Volume
N
W
E
S
CTPS

Figure E-7

2025 Peak Period Traffic Volumes
Exit 16
Route 128 @ Pine Street, Manchester



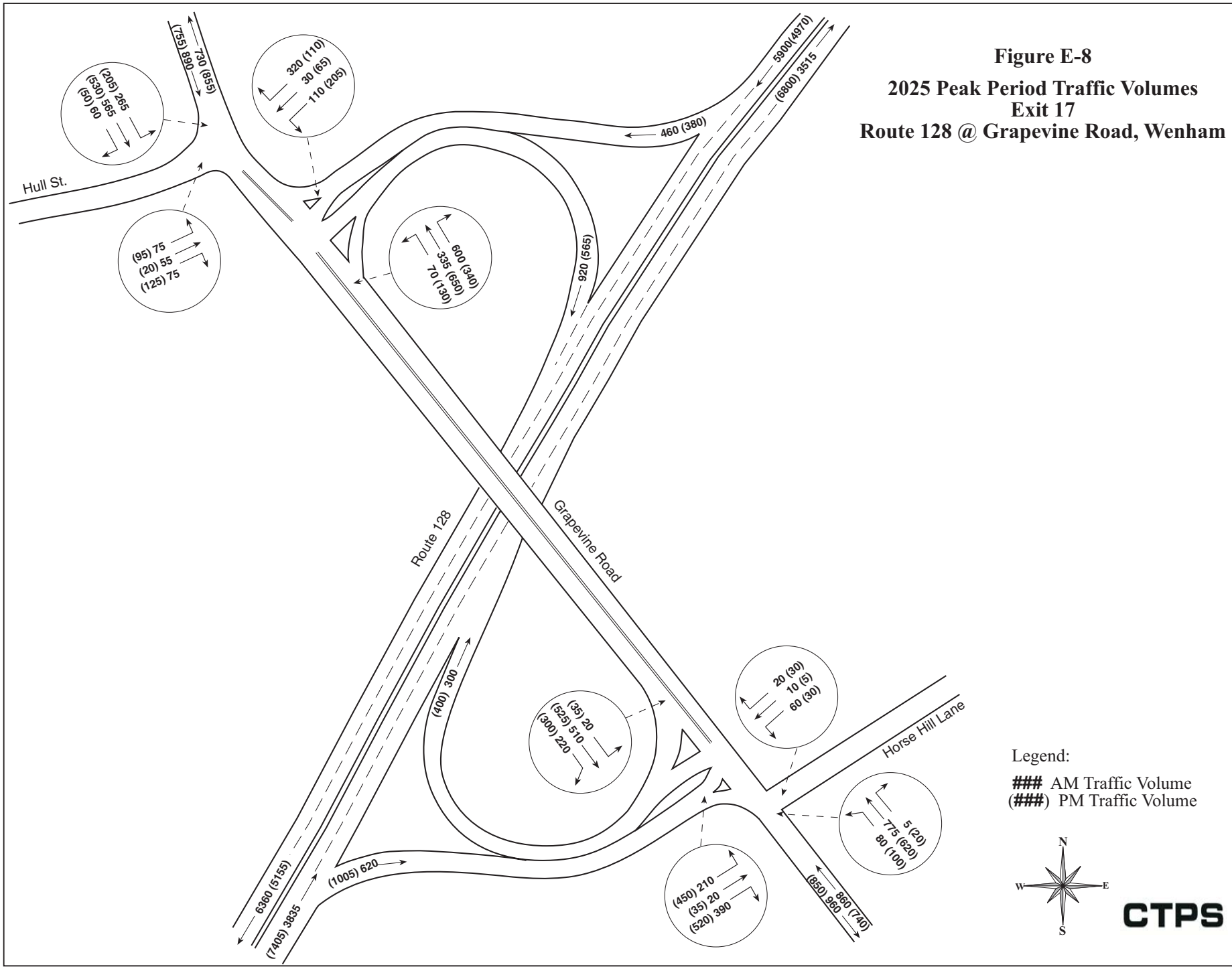


Figure E-8

2025 Peak Period Traffic Volumes
Exit 17
Route 128 @ Grapevine Road, Wenham

Figure E-9

2025 Peak Period Traffic Volumes
Exit 18
Route 128 @ Essex Street, Beverly

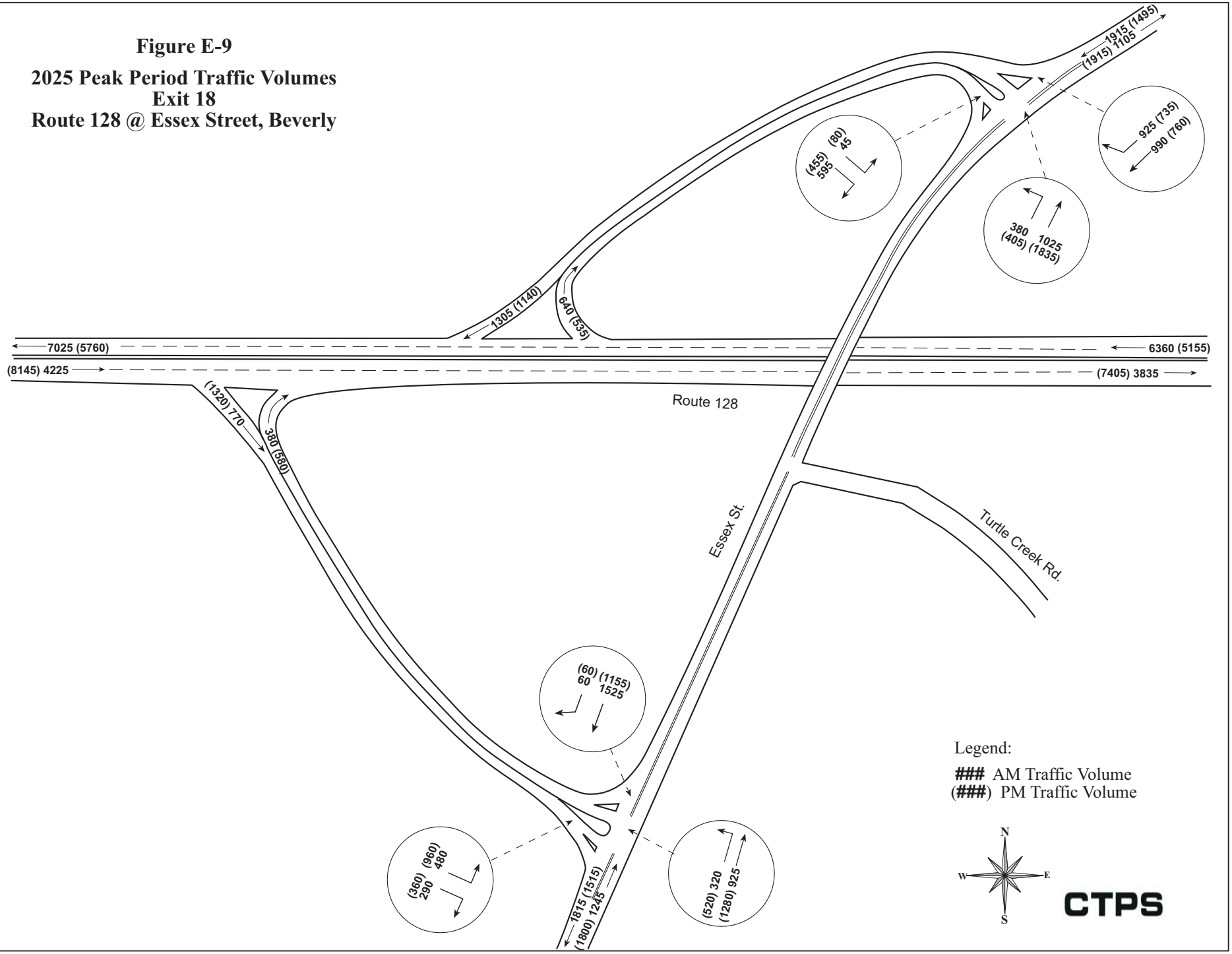


Figure E-10

2025 Peak Period Traffic Volumes
Exit 19
Route 128 @ Brimbal Avenue, Beverly

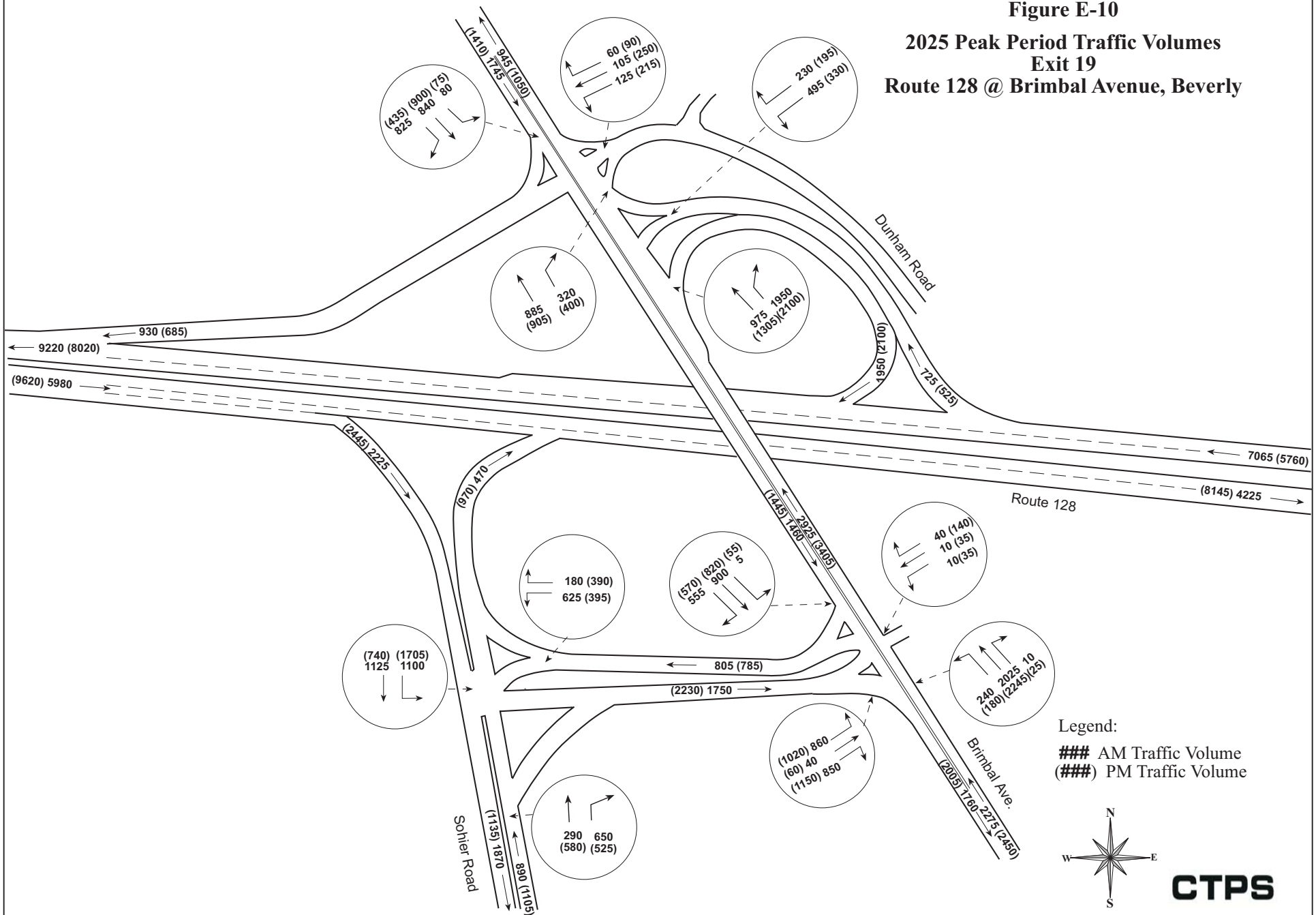
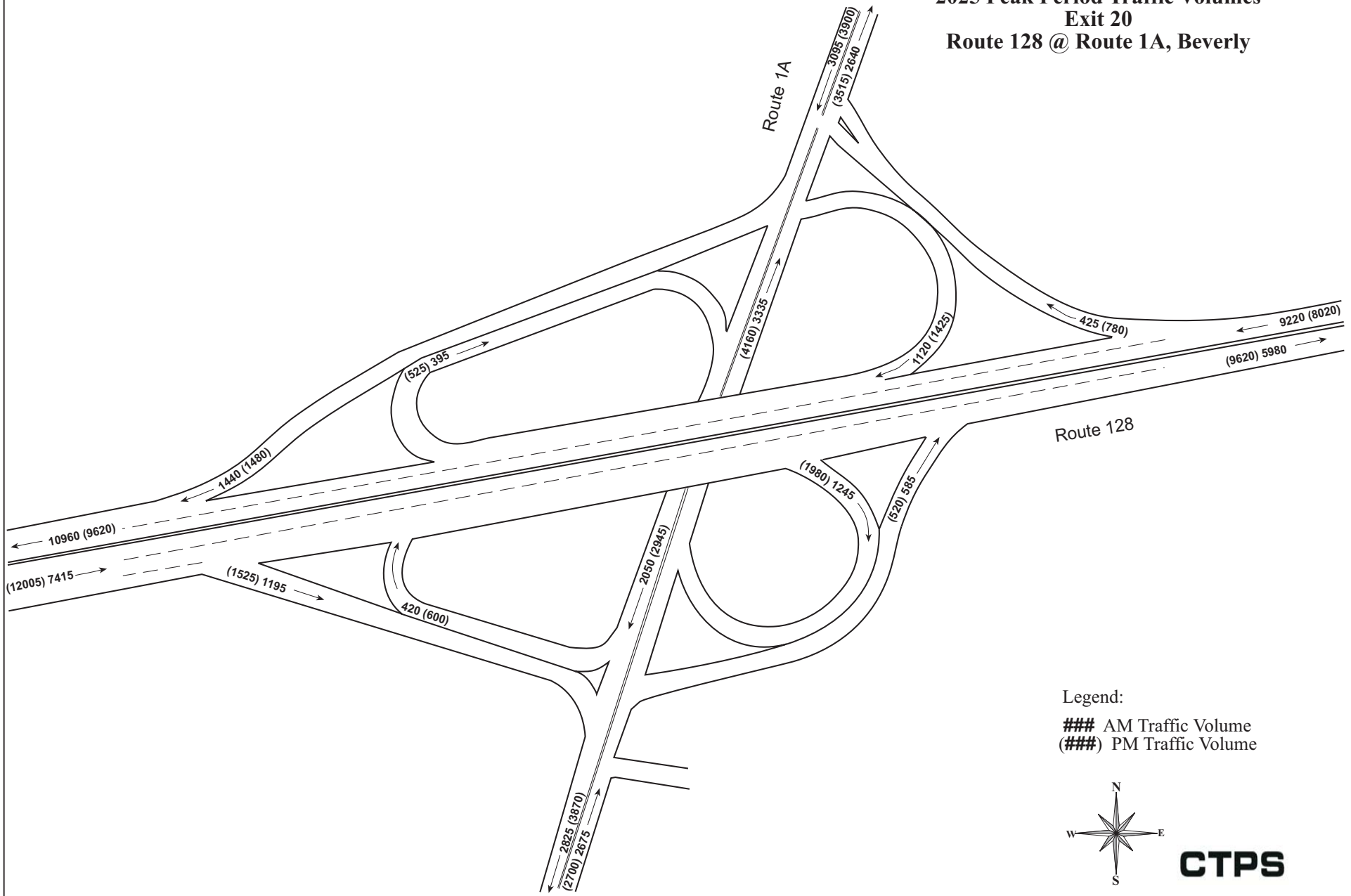


Figure E-11

2025 Peak Period Traffic Volumes
Exit 20
Route 128 @ Route 1A, Beverly



APPENDIX F

Future (2025) No-Build Peak Hour Traffic Volume Forecasts

Figure F-1

2025 Peak Hour Traffic Volumes
Exit 10
Route 128 @ Blackburn Circle, Gloucester

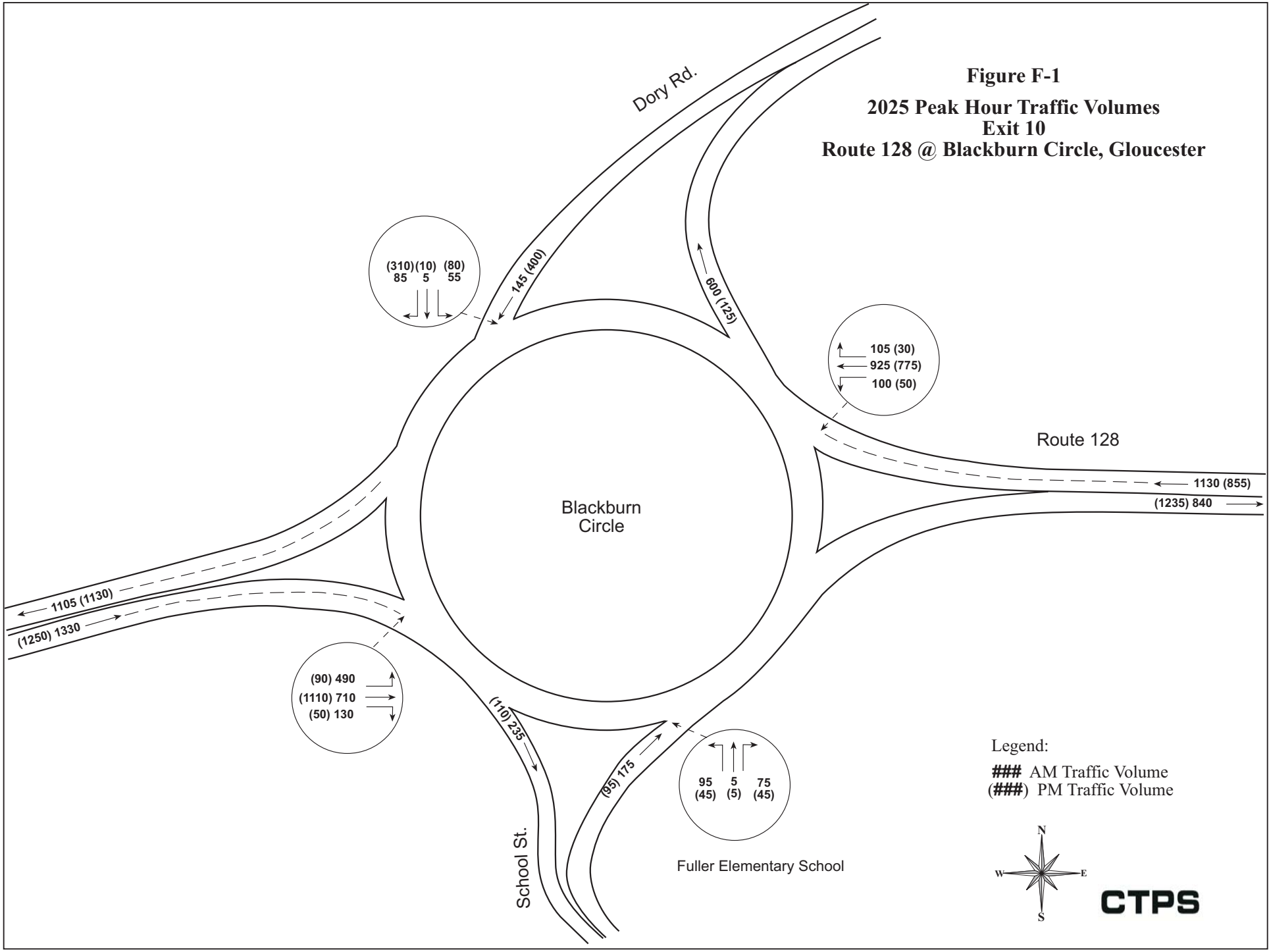


Figure F-2

2025 Peak Hour Traffic Volumes
Exit 11
Route 128 @ Grant Circle, Gloucester

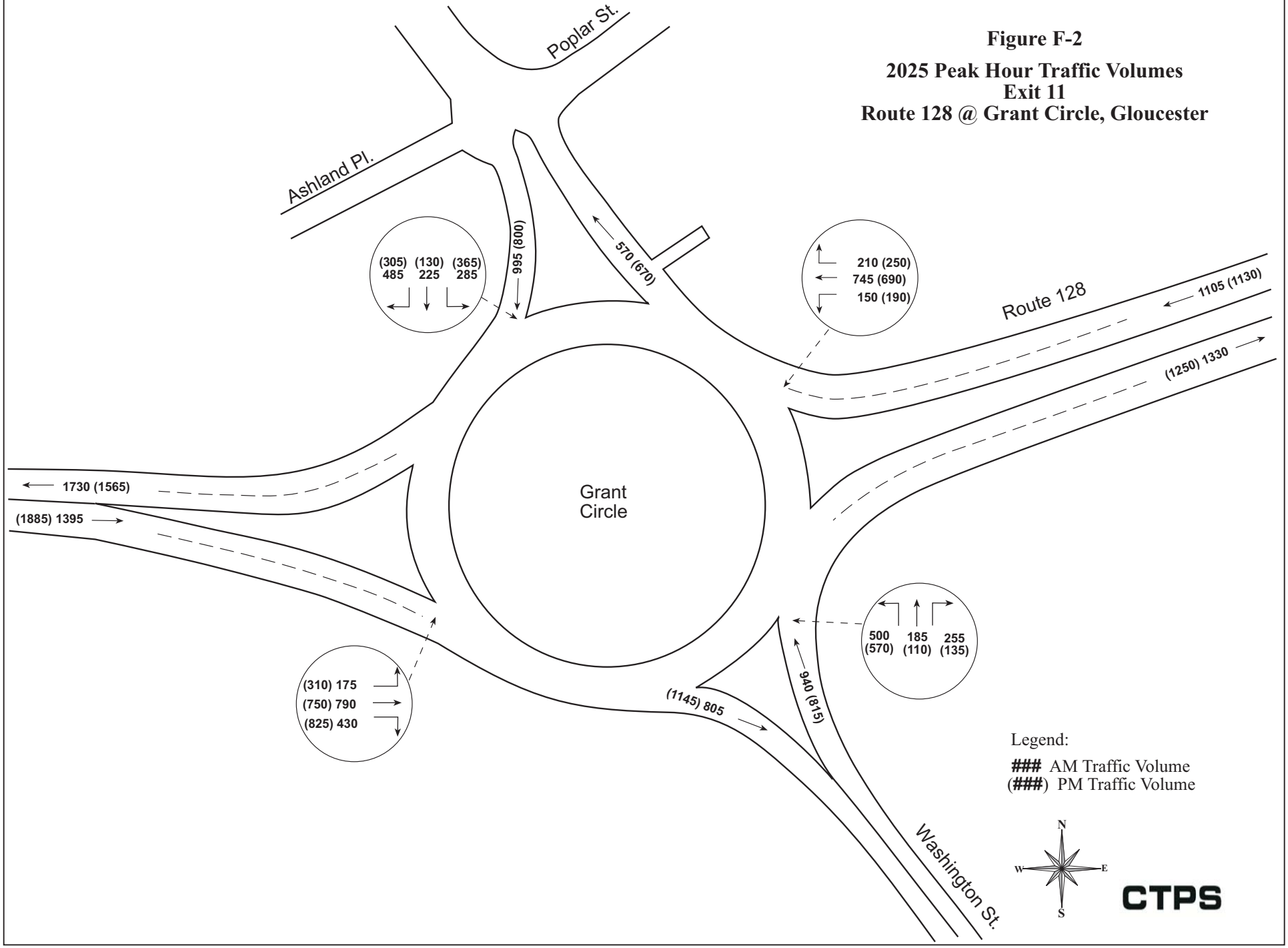


Figure F-3

2025 Peak Hour Traffic Volumes
Exit 12
Route 128 @ Craft's Road, Gloucester

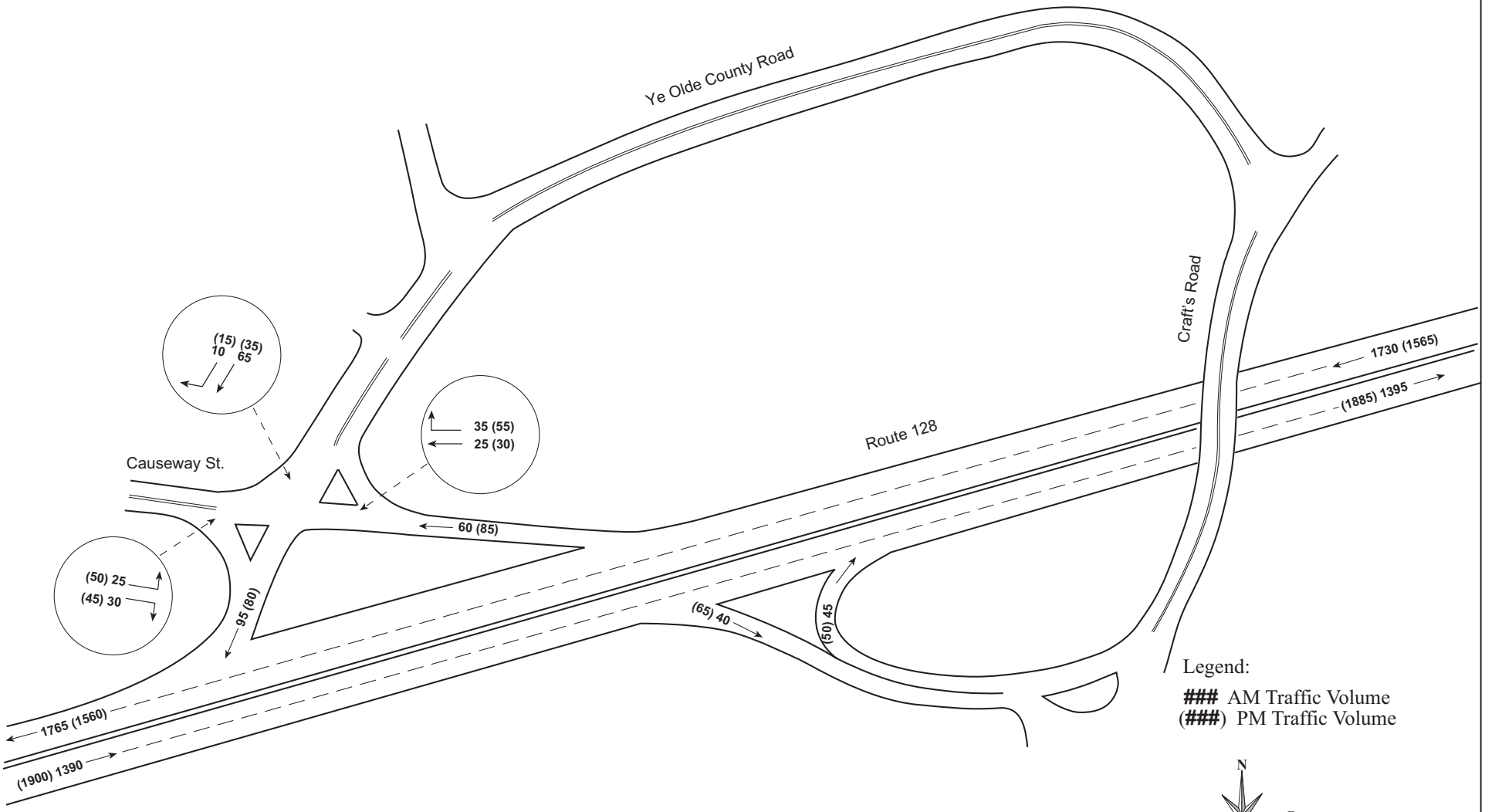
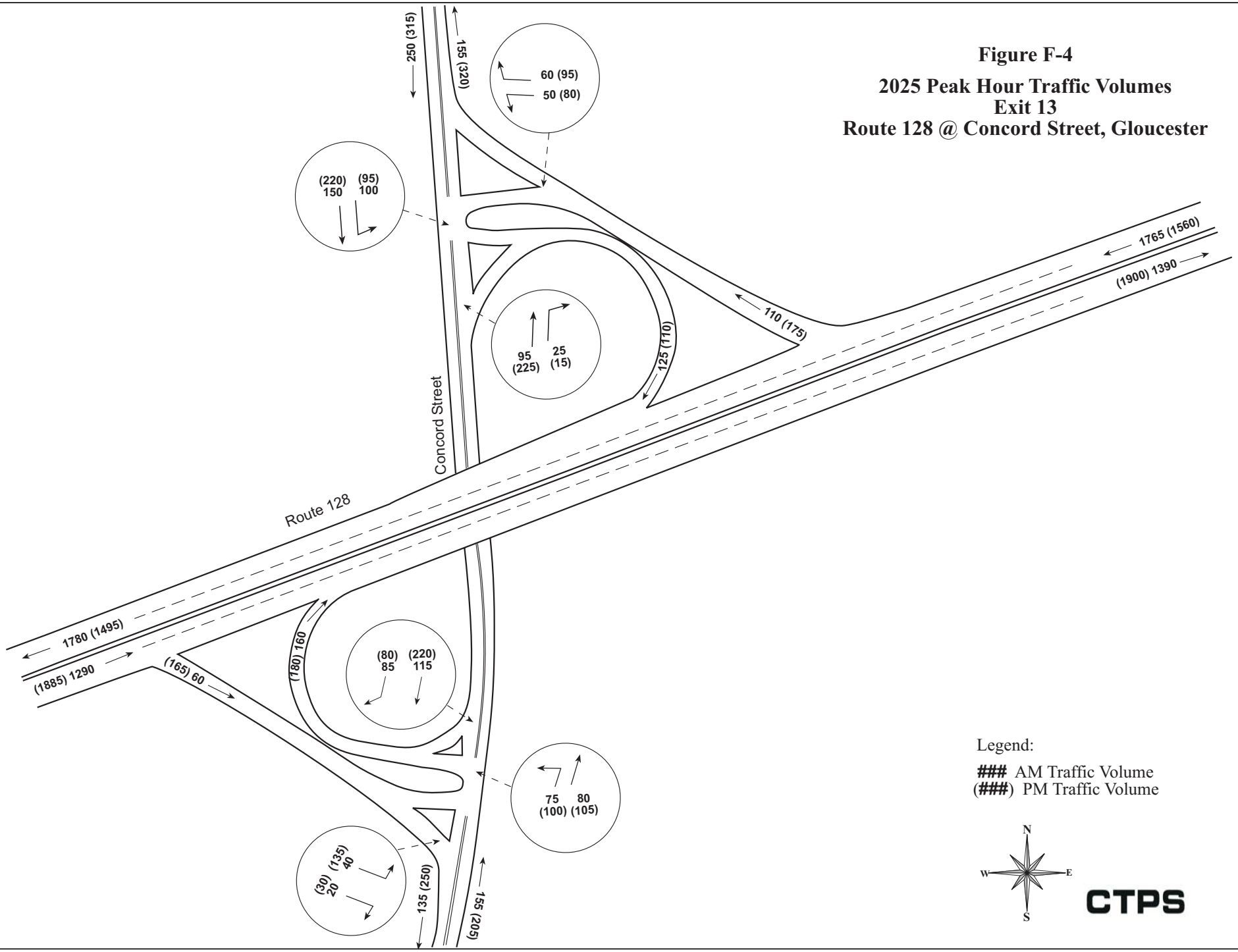


Figure F-4

2025 Peak Hour Traffic Volumes
Exit 13
Route 128 @ Concord Street, Gloucester



Legend:

AM Traffic Volume
(**###**) PM Traffic Volume

N
W
E
S

CTPS

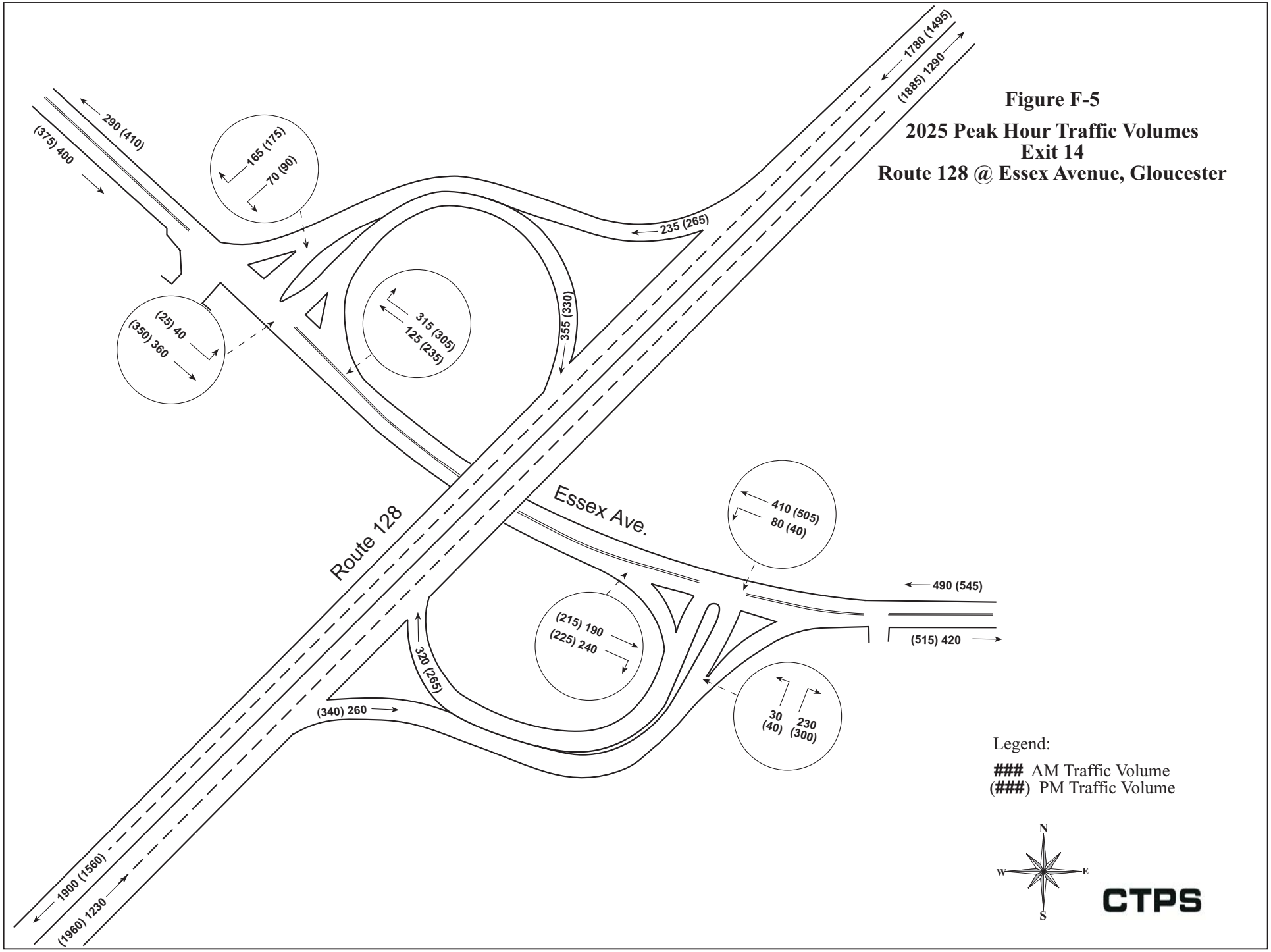


Figure F-5
2025 Peak Hour Traffic Volumes
Exit 14
Route 128 @ Essex Avenue, Gloucester
290 (410)
(375) 400
165 (175)
70 (90)
1780 (1495)
(1885) 1290
235 (265)
315 (305)
125 (235)
355 (330)
(25) 40
(350) 360
Route 128
Essex Ave.
410 (505)
80 (40)
490 (545)
(215) 190
(225) 240
320 (265)
(515) 420
(340) 260
30
(40)
230
(300)
1900 (1560)
(1960) 1230
Legend:
AM Traffic Volume
(###) PM Traffic Volume
N
W
E
S
CTPS

Figure F-6

2025 Peak Hour Traffic Volumes
Exit 15
Route 128 @ School Street, Manchester

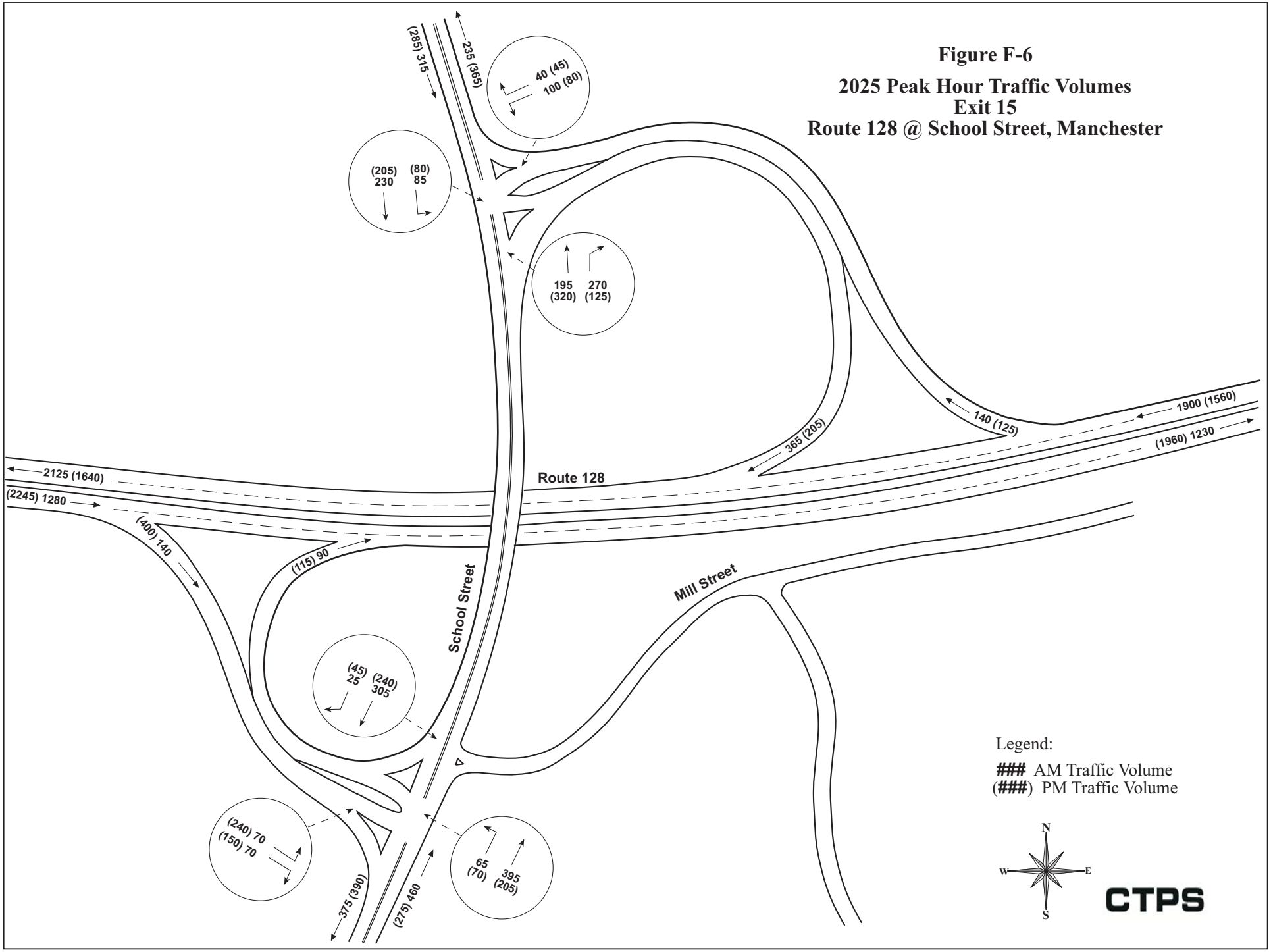
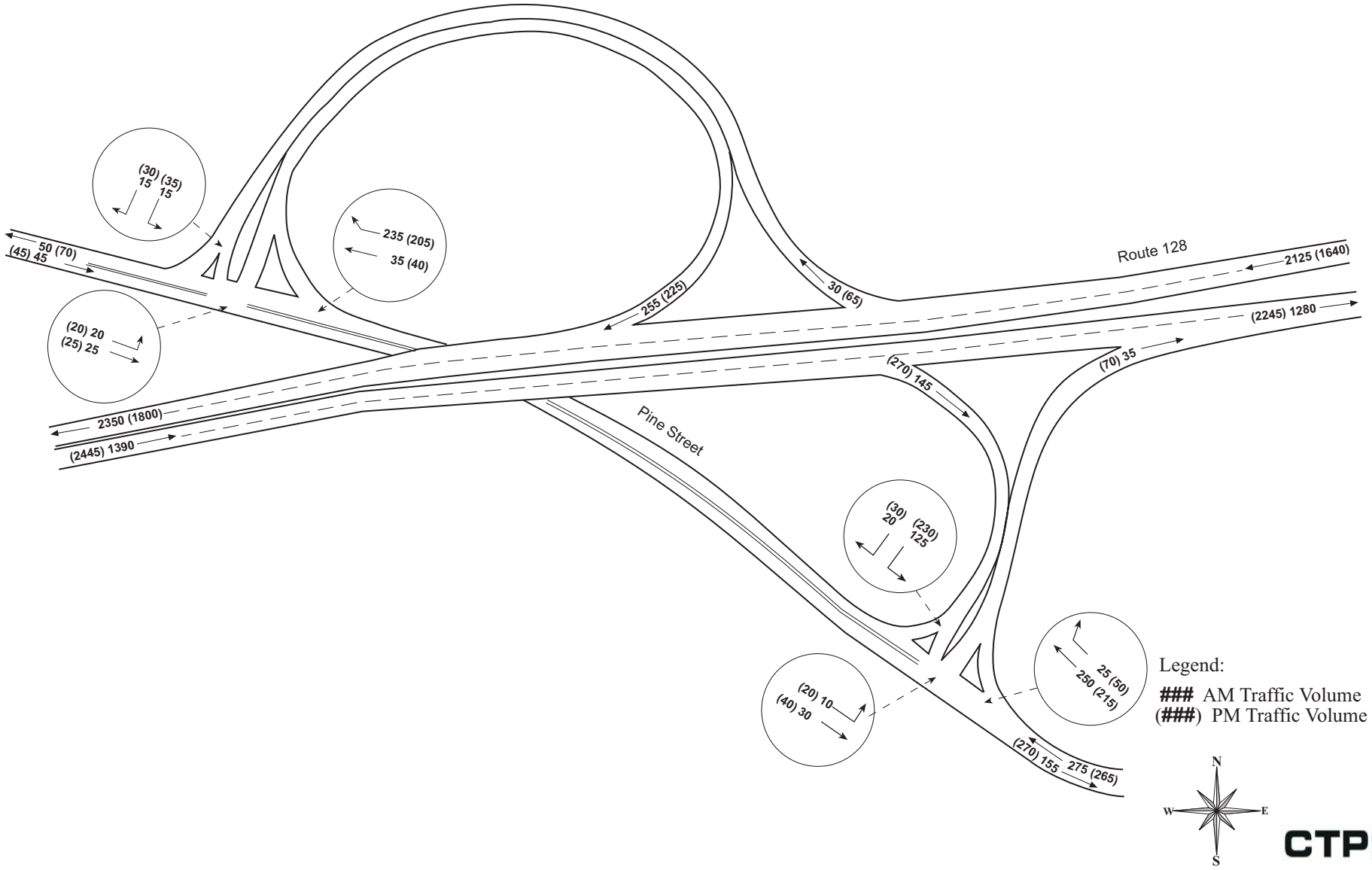


Figure F-7

2025 Peak Hour Traffic Volumes
Exit 16
Route 128 @ Pine Street, Manchester



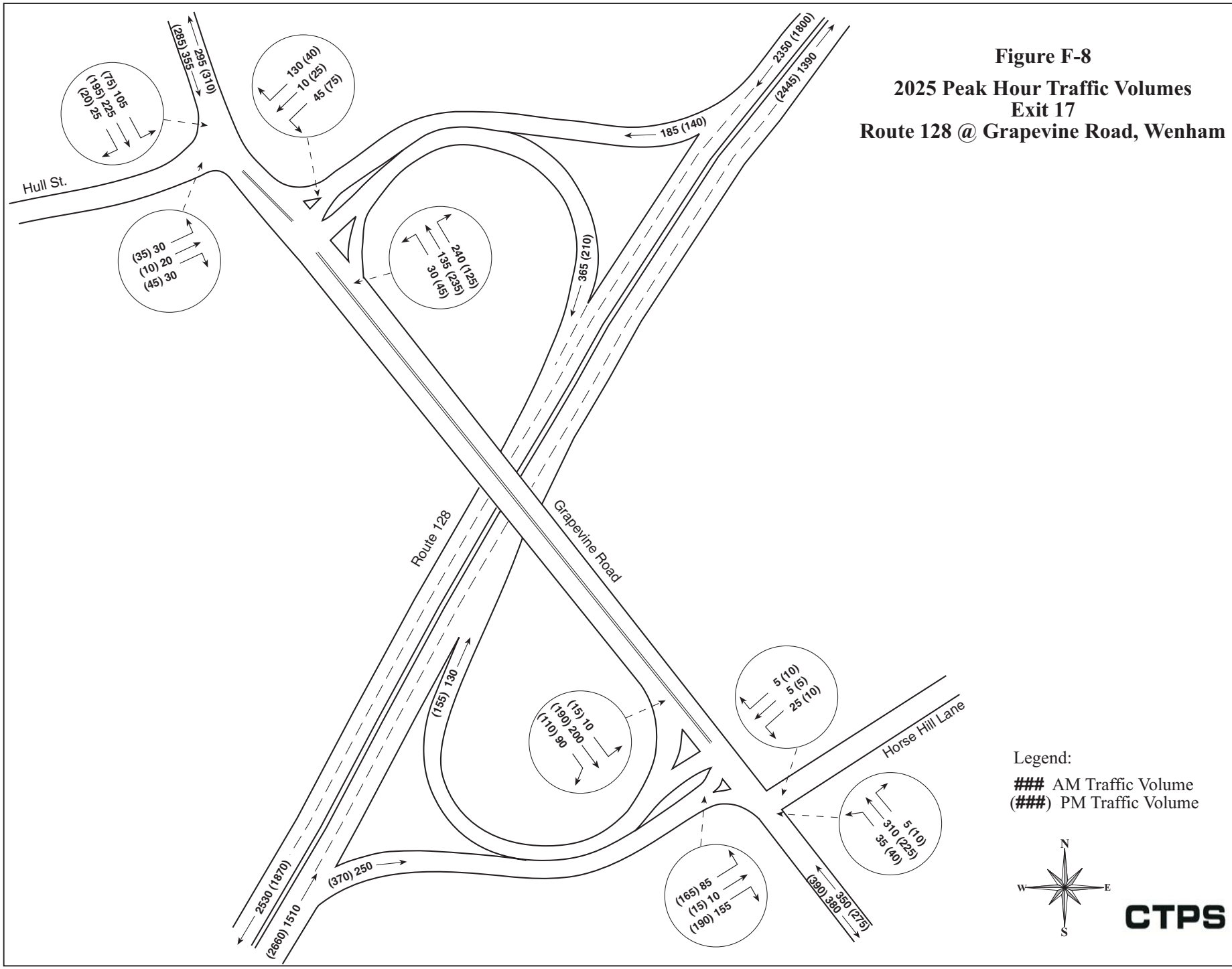


Figure F-8

2025 Peak Hour Traffic Volumes
Exit 17
Route 128 @ Grapevine Road, Wenham

Figure F-9

2025 Peak Hour Traffic Volumes
Exit 18
Route 128 @ Essex Street, Beverly

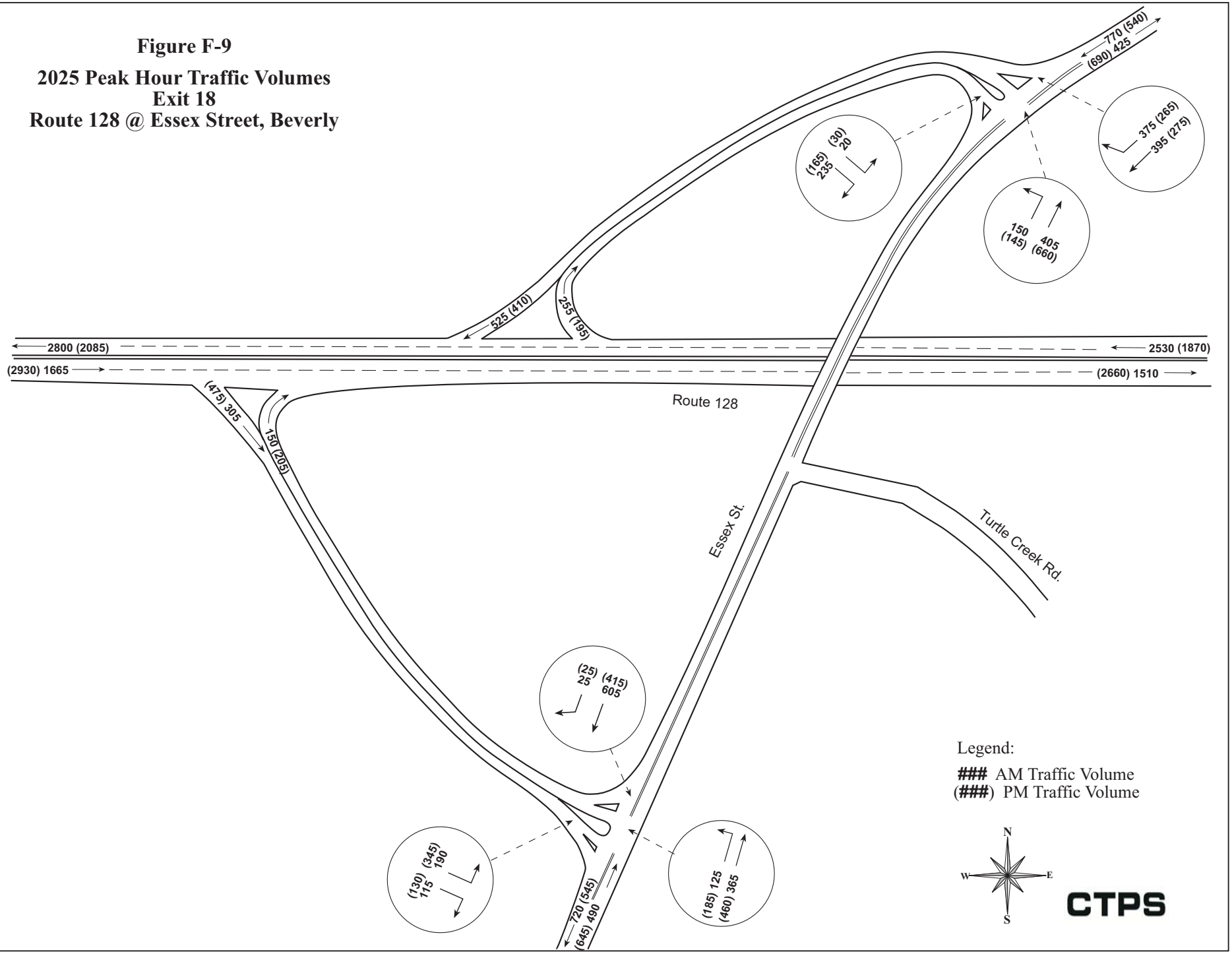


Figure F-10

2025 Peak Hour Traffic Volumes
Exit 19
Route 128 @ Brimbal Avenue, Beverly

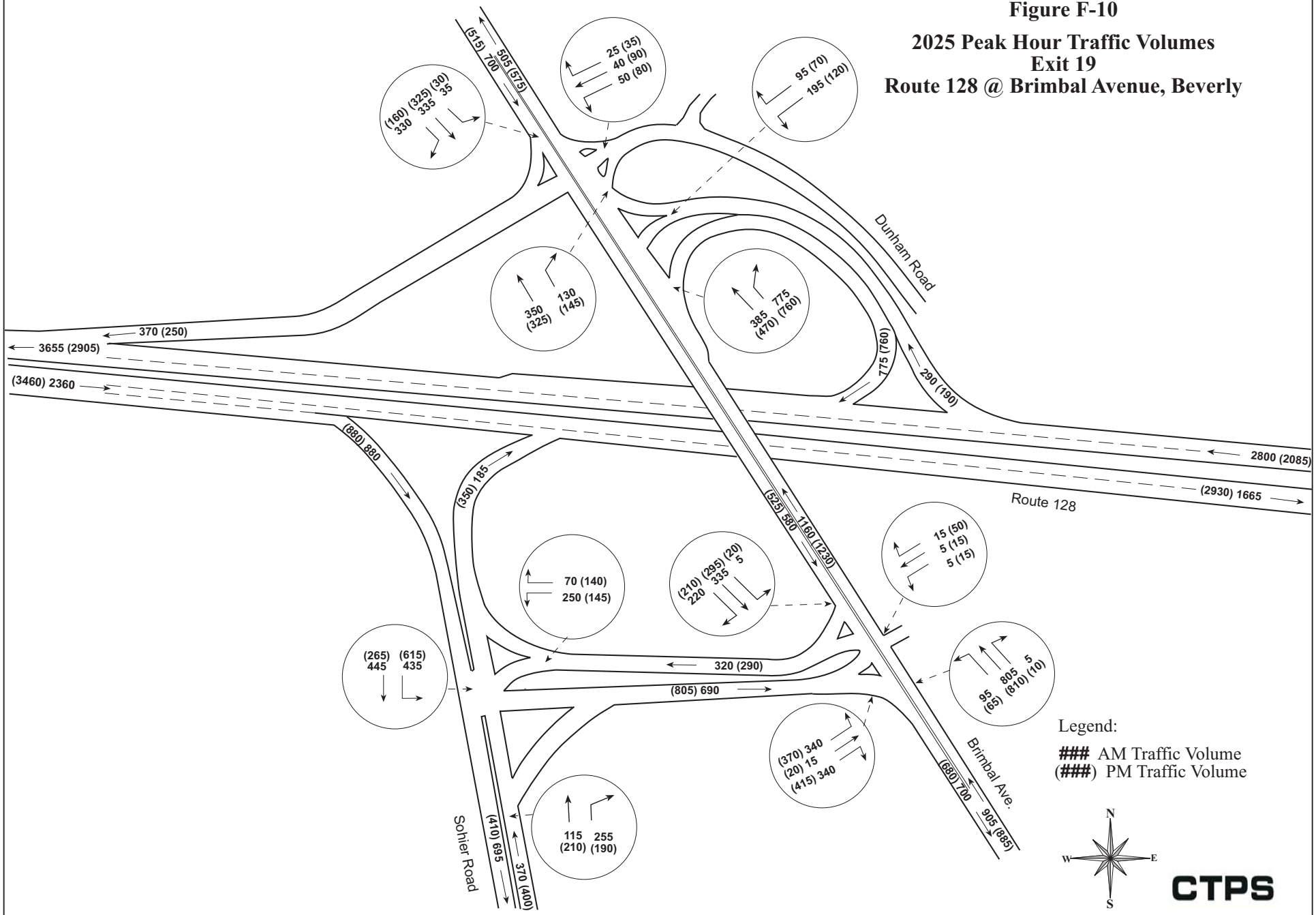
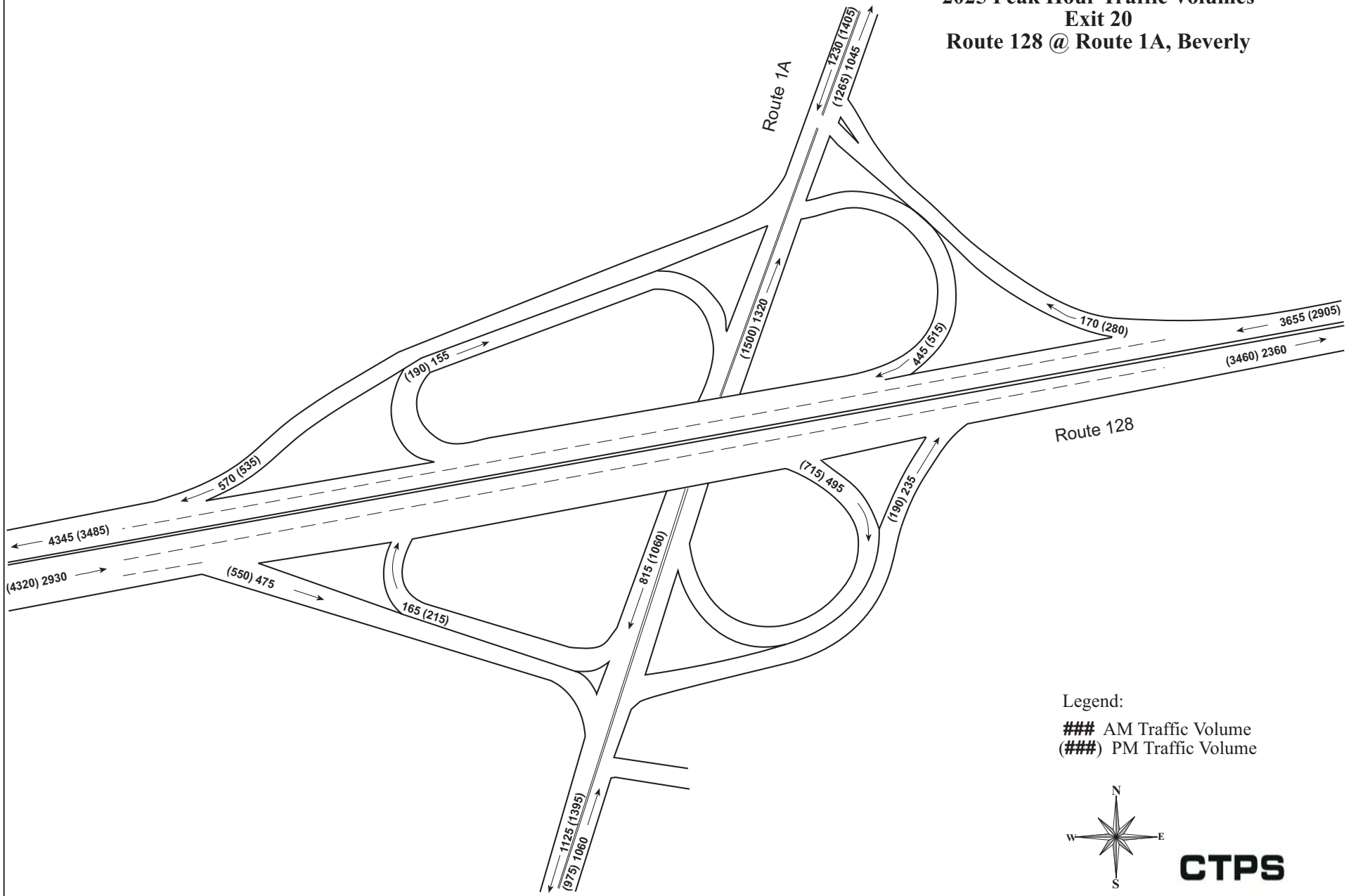


Figure F-11

2025 Peak Hour Traffic Volumes
Exit 20
Route 128 @ Route 1A, Beverly



Legend:

AM Traffic Volume
(###) PM Traffic Volume

N
W E
S

CTPS

APPENDIX G

Future (2025) No-Build Interchange Capacity Analyses

Figure G-1

2025 Peak Hour Capacity Analysis
Exit 10
Route 128 @ Blackburn Circle, Gloucester

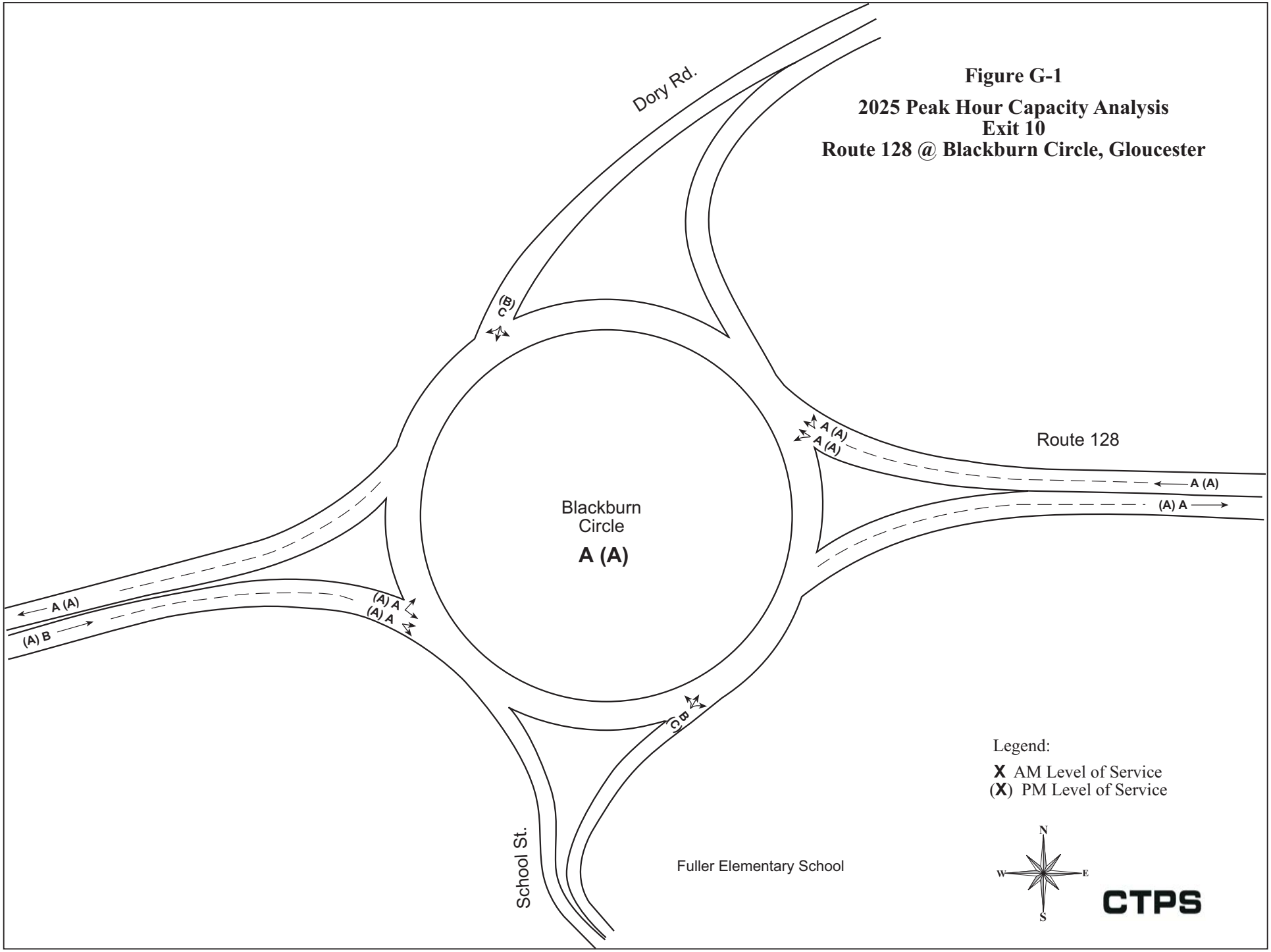


Figure G-2

2025 Peak Hour Capacity Analysis
Exit 11
Route 128 @ Grant Circle, Gloucester

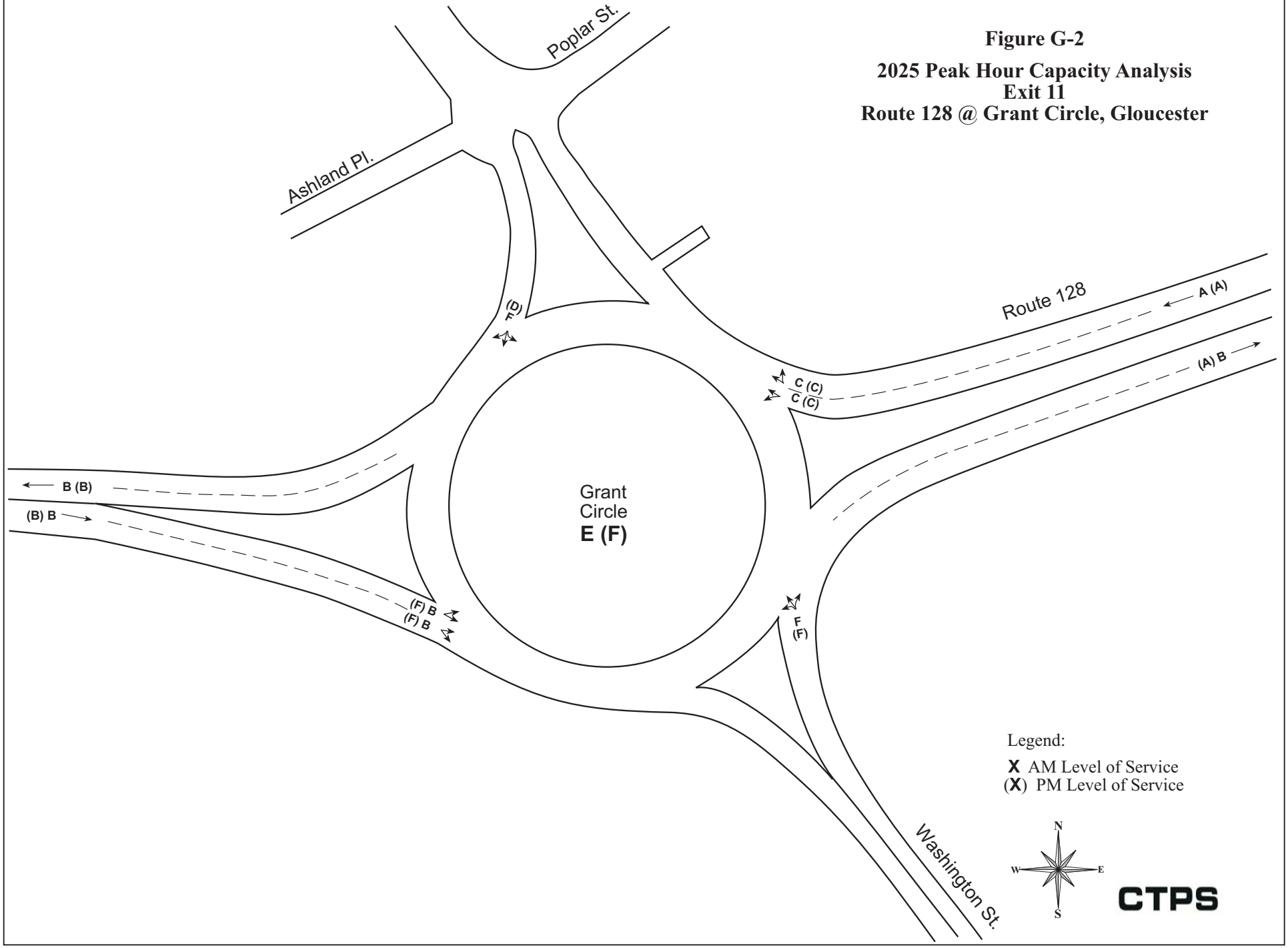


Figure G-3

2025 Peak Hour Capacity Analysis
Exit 12
Route 128 @ Craft's Road, Gloucester

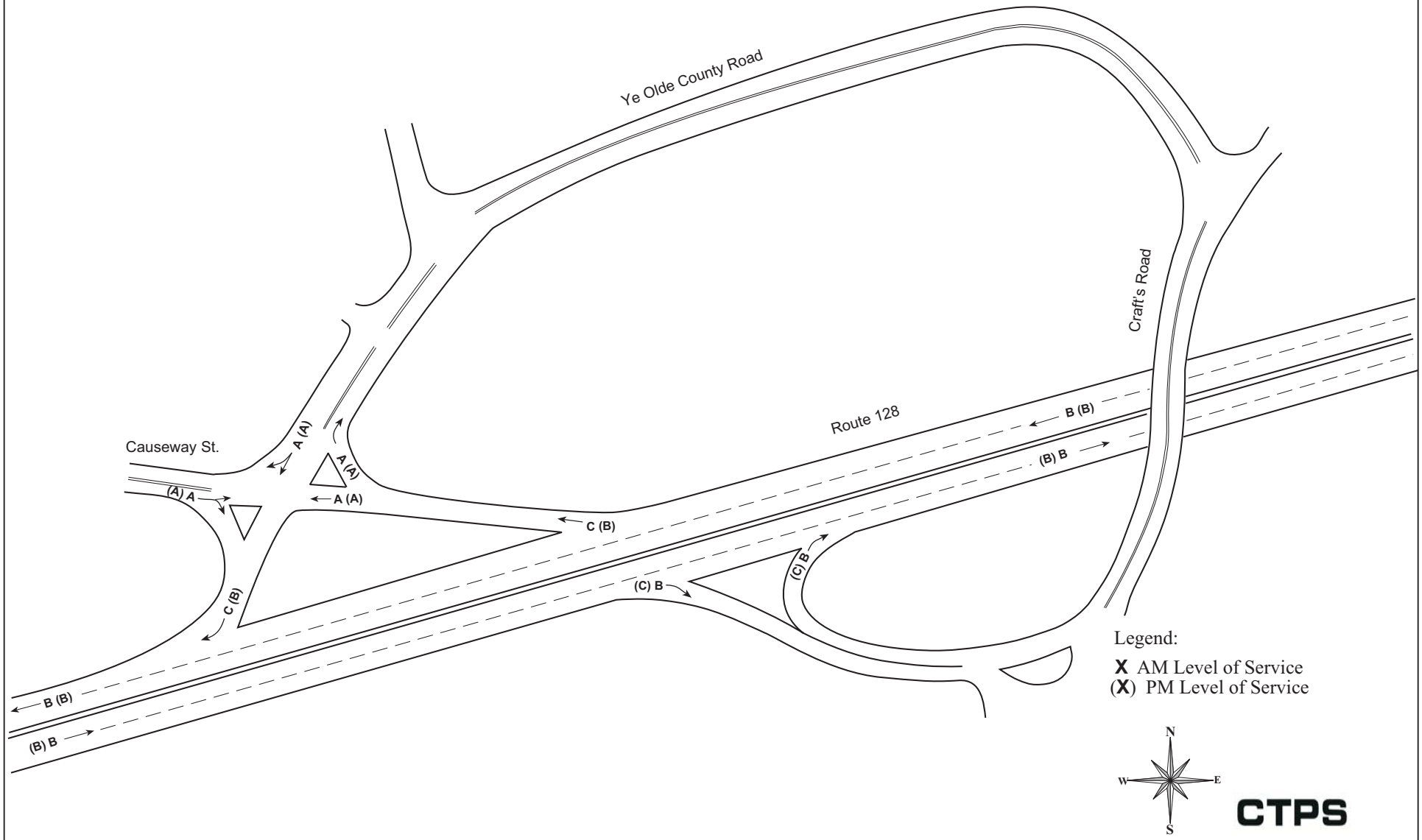
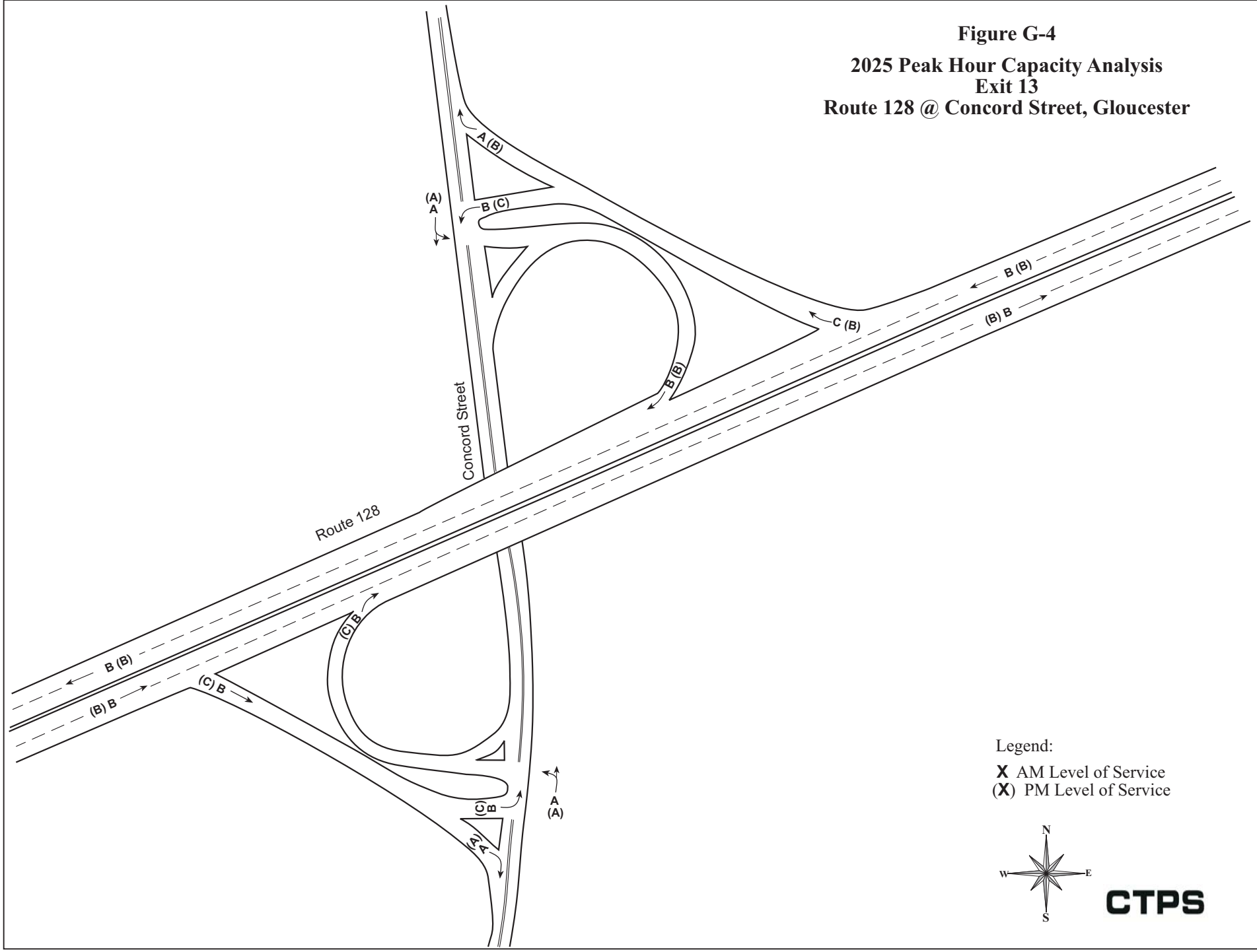


Figure G-4

2025 Peak Hour Capacity Analysis
Exit 13
Route 128 @ Concord Street, Gloucester



Legend:

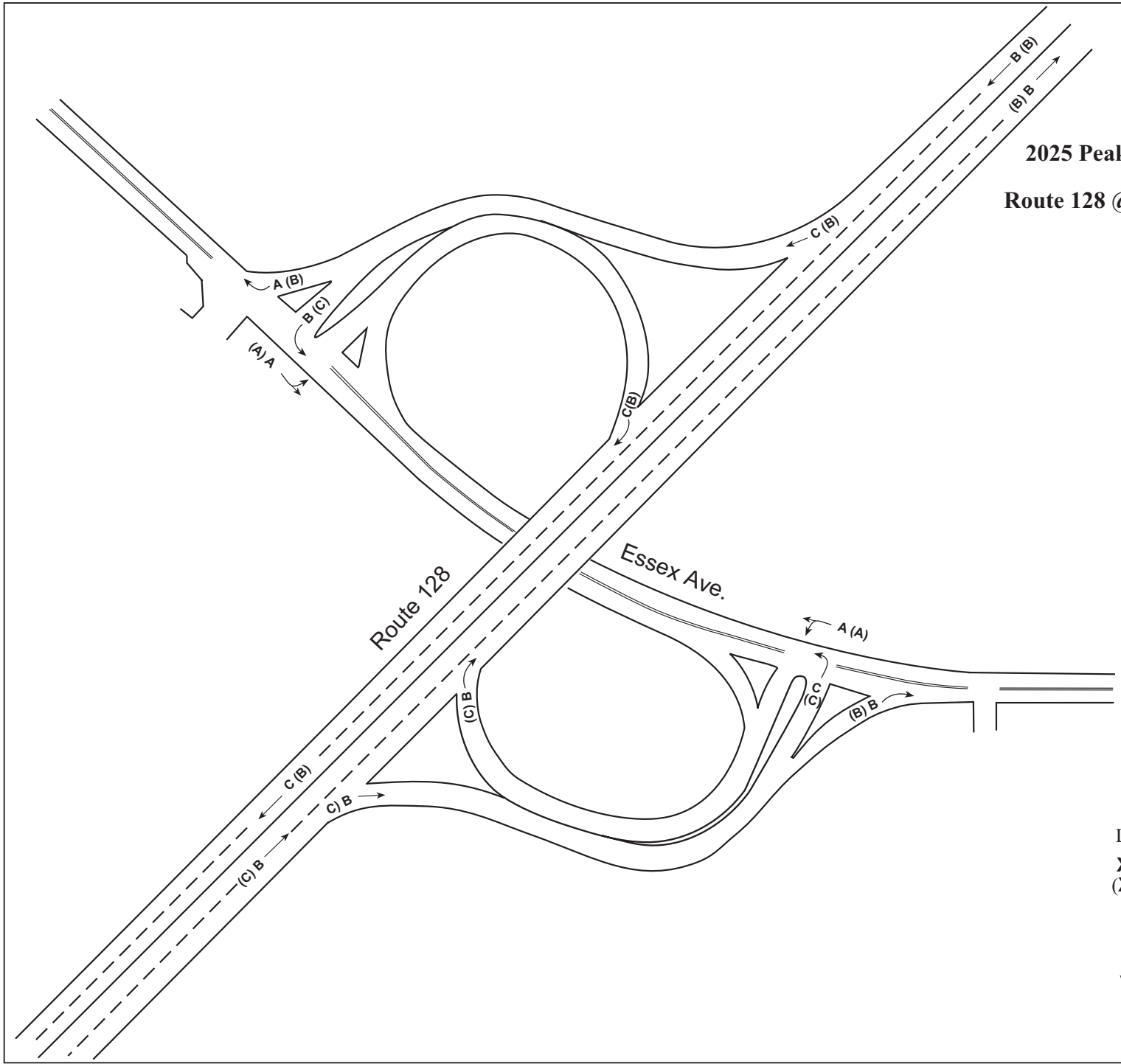
X AM Level of Service
(**X**) PM Level of Service

N
W
E
S

CTPS

Figure G-5

2025 Peak Hour Capacity Analysis
Exit 14
Route 128 @ Essex Avenue, Gloucester



Legend:

X AM Level of Service
(**X**) PM Level of Service

N
W
E
S

CTPS

Figure G-6

2025 Peak Hour Capacity Analysis
Exit 15
Route 128 @ School Street, Manchester

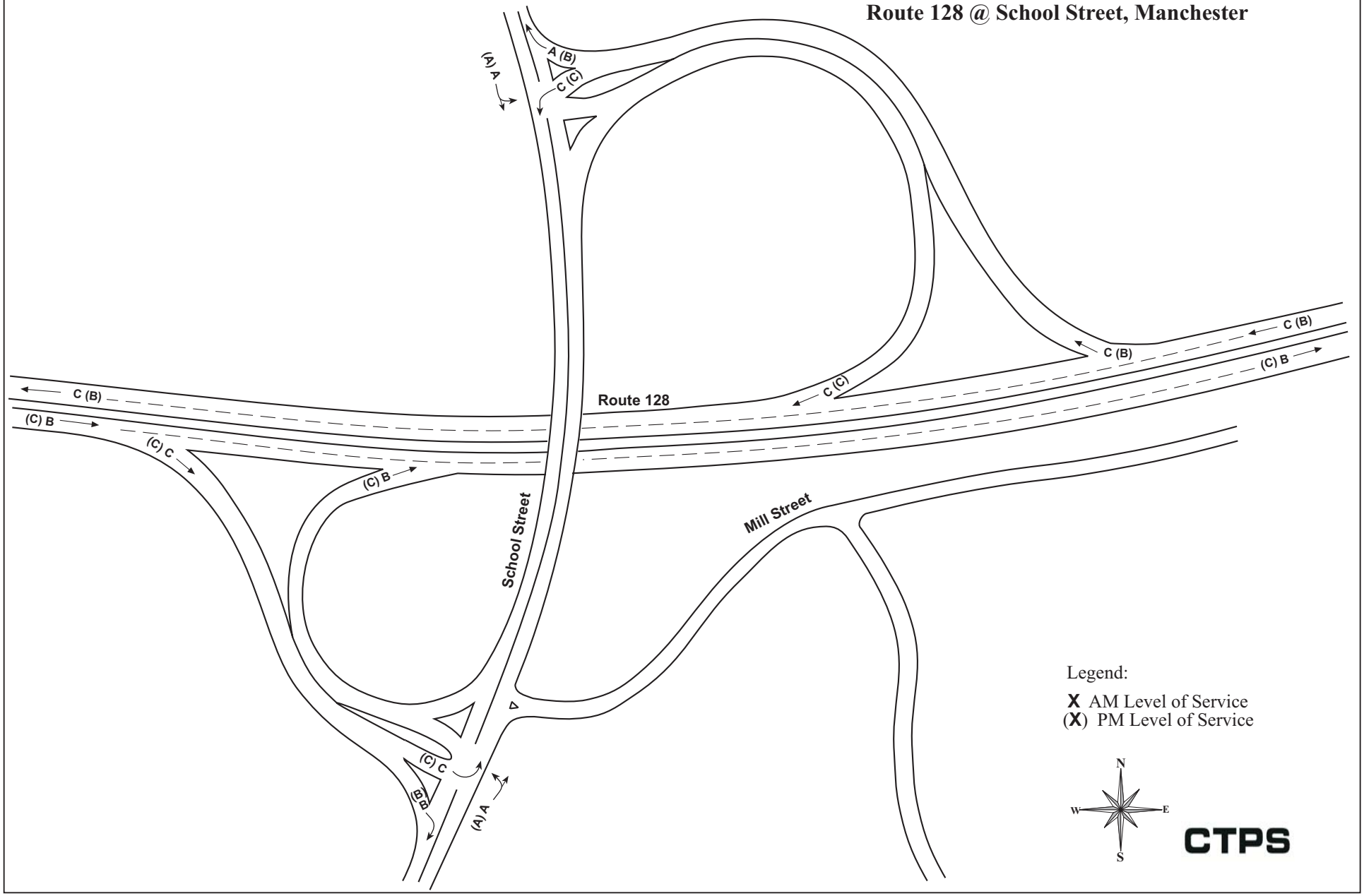


Figure G-7

2025 Peak Hour Capacity Analysis
Exit 16
Route 128 @ Pine Street, Manchester

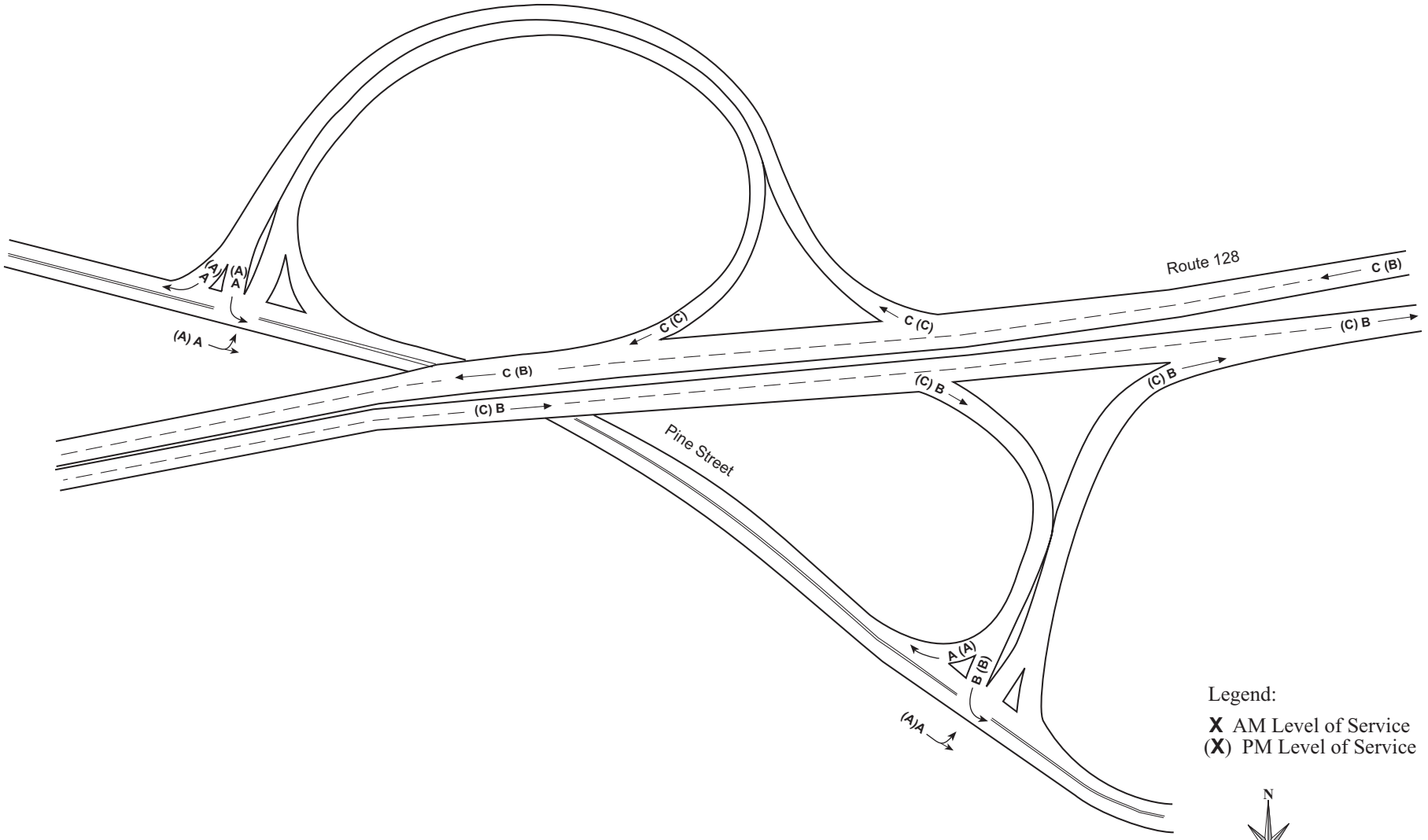
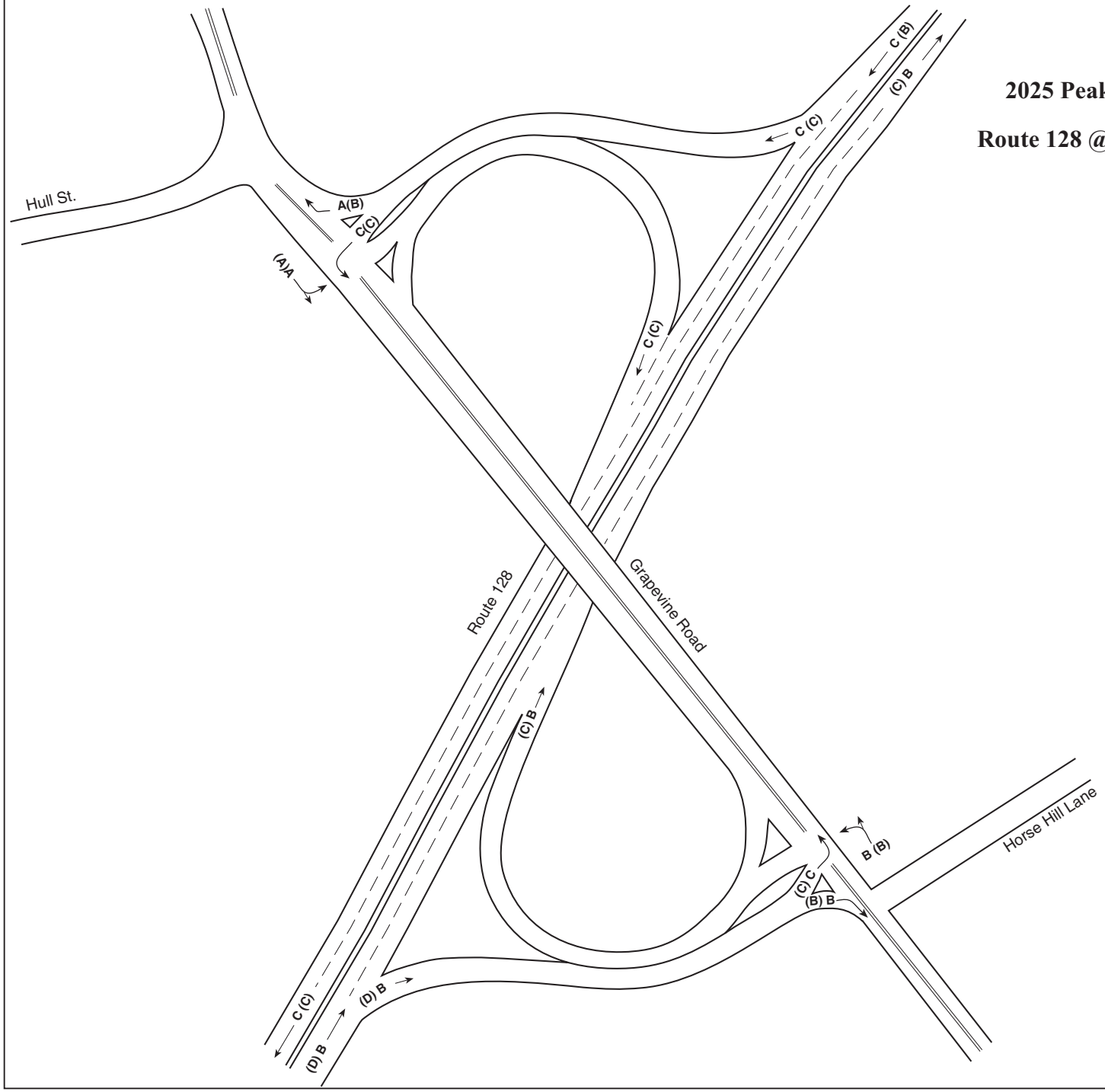


Figure G-8

2025 Peak Hour Capacity Analysis
Exit 17
Route 128 @ Grapevine Road, Wenham



Legend:

X AM Level of Service
(**X**) PM Level of Service

N
W
E
S

CTPS

Figure G-9

2025 Peak Hour Capacity Analysis
Exit 18
Route 128 @ Essex Street, Beverly

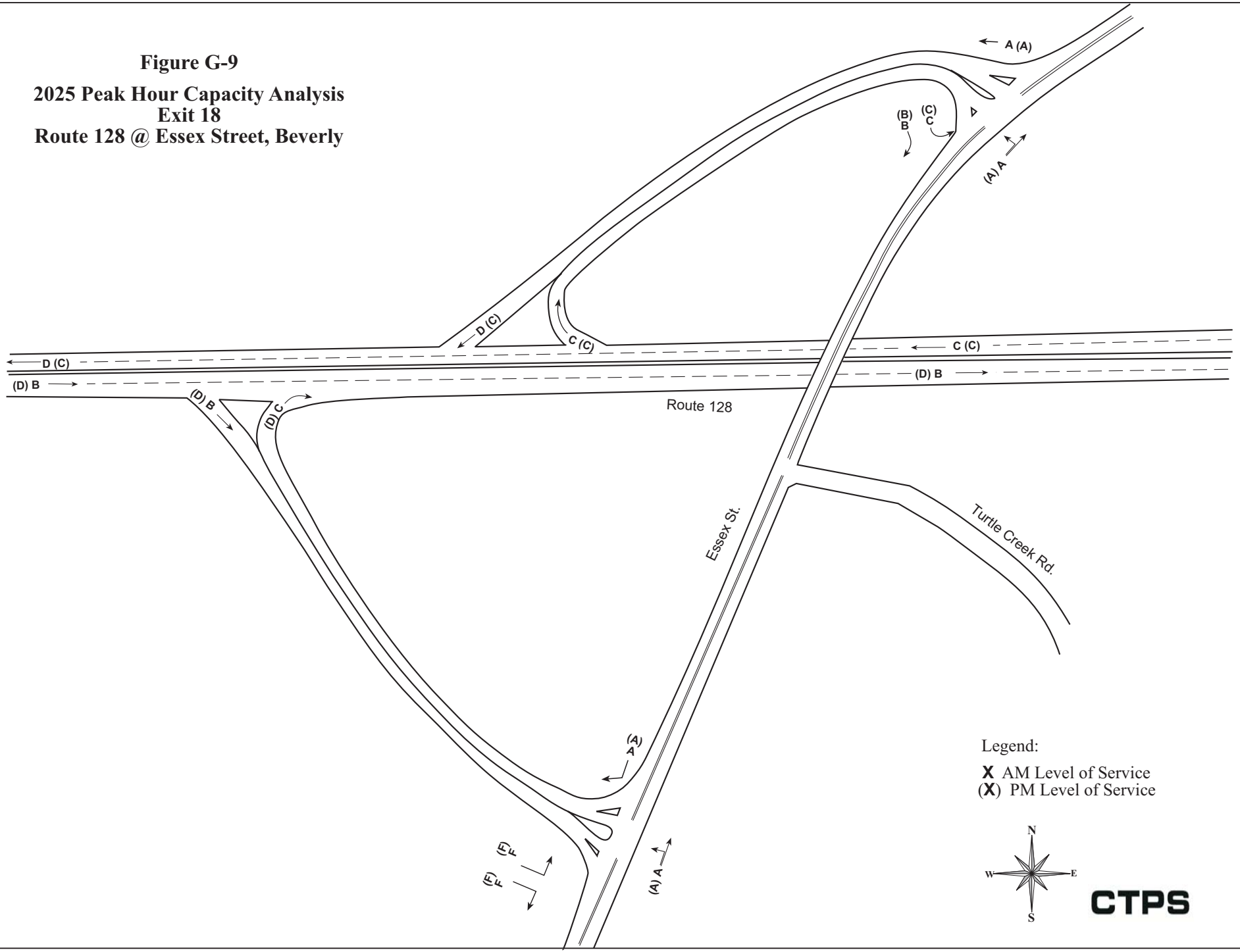


Figure G-10

2025 Peak Hour Capacity Analysis
Exit 19
Route 128 @ Brimbal Avenue, Beverly

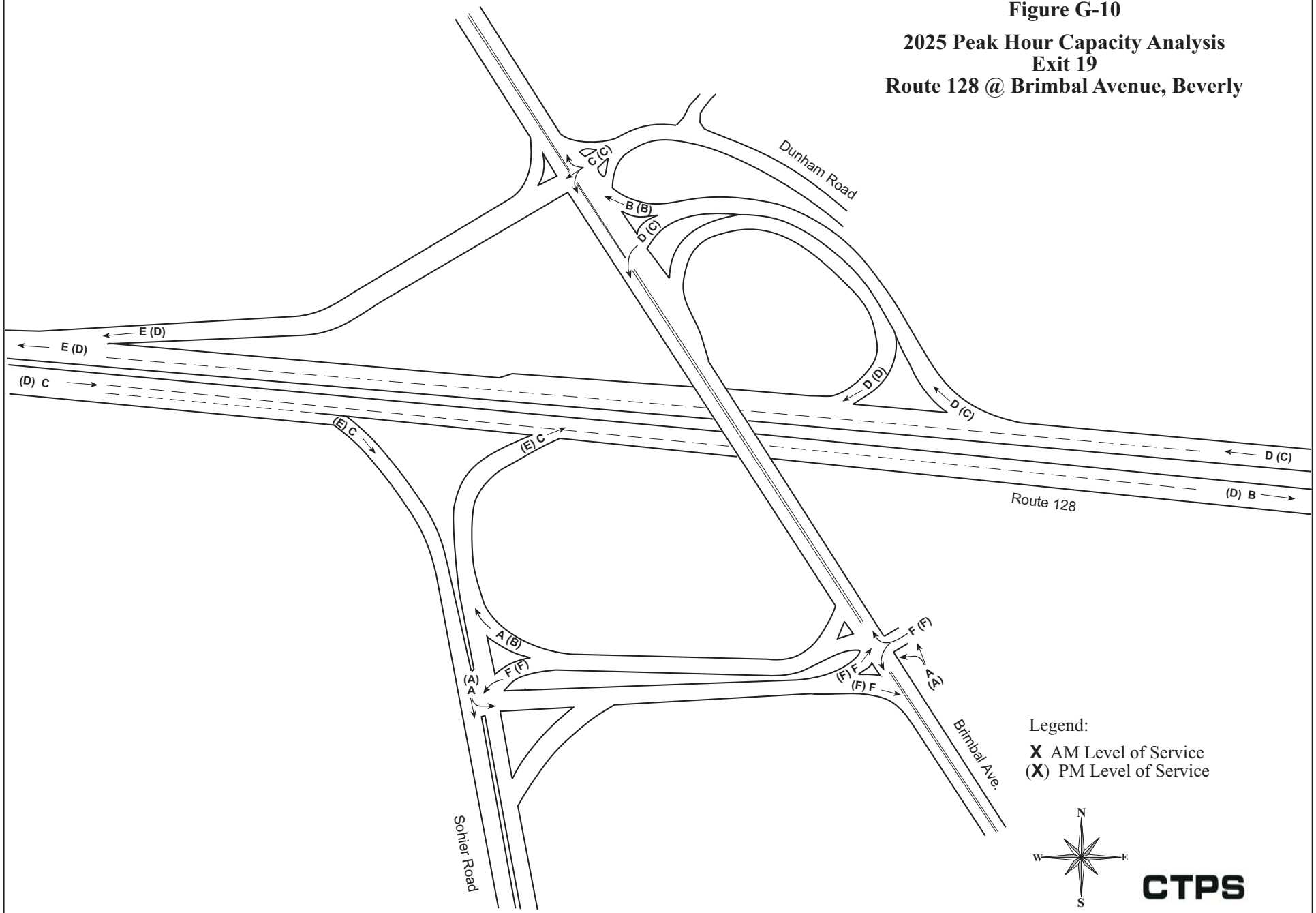
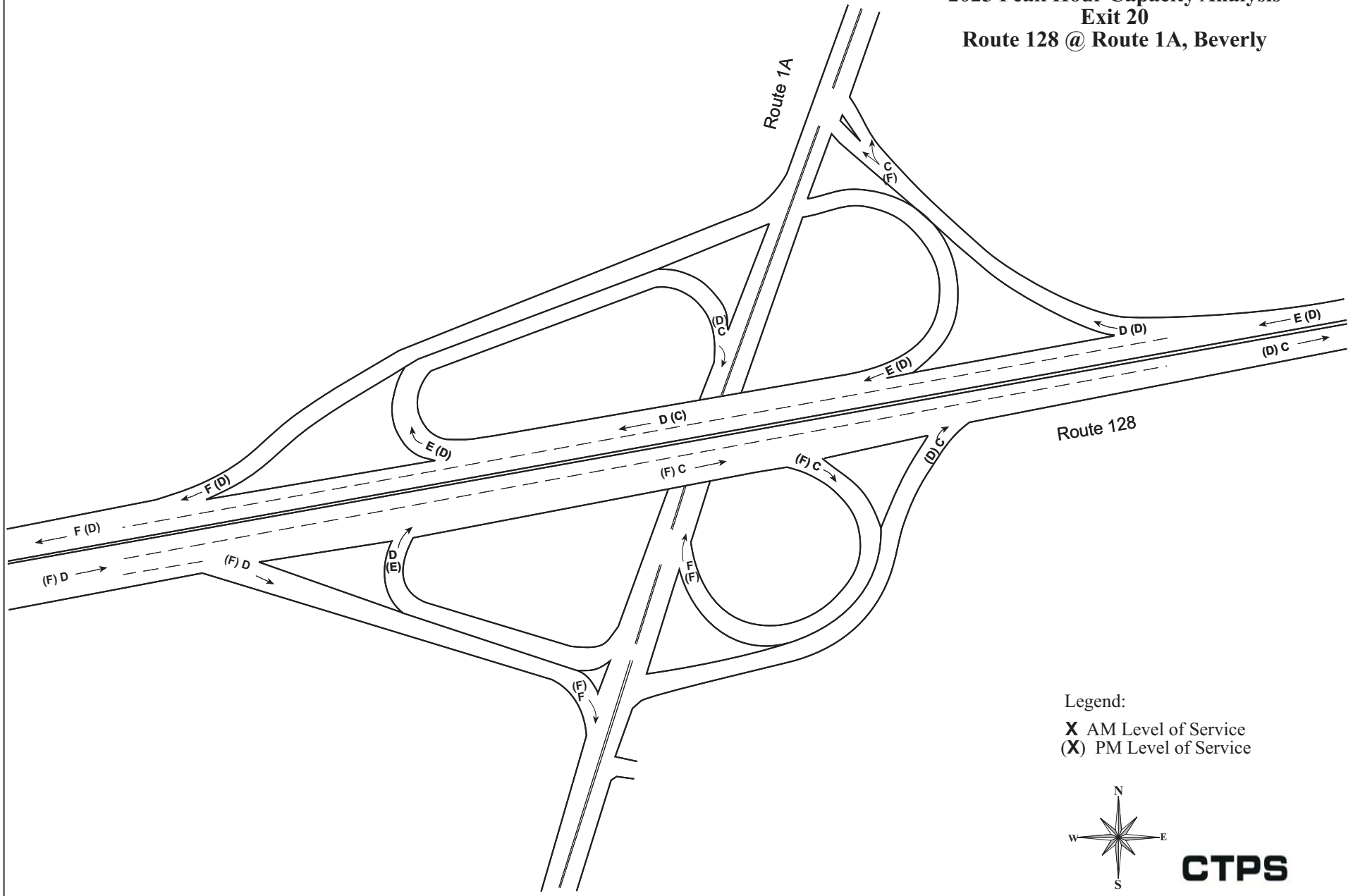


Figure G-11

2025 Peak Hour Capacity Analysis
Exit 20
Route 128 @ Route 1A, Beverly



Legend:

X AM Level of Service
(**X**) PM Level of Service

N
W
E
S

CTPS